# GuardShield™ Safe 4 and Safe 4 PAC Safety Light Curtains User Manual

Allen-Bradley

Allen-Bradley • Rockwell Software

Rockwell Automation

## Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in the guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control (available from your local Rockwell Automation sales office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:

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| **WARNING** | Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |
| **ATTENTION** | Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequences. |
| **SHOCK HAZARD** | Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present. |
| **BURN HAZARD** | Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures. |

It is recommended that you save this user manual for future use.

# Conditions required for proper use of the GuardShield Safe 4 Safety Light Curtain

Please make sure you read and understand these requirements before you select and install the GuardShield Safe 4 safety light curtain. GuardShield safety light curtains are point of operation and perimeter access safeguarding devices. These safety light curtains are intended to be used to to provide point of operation and perimeter access safeguarding of personnel on a variety of machinery.

The GuardShield Safe 4 family of safety light curtains are general purpose presence sensing devices which are designed to protect personnel working on or near machinery.

The installation of GuardShield Safe 4 safety light curtains must comply with all applicable federal, state, and local rules, regulations, and codes.

It is the responsibility of the employer to properly install, operate and maintain the product as well as the machinery on which the GuardShield Safe 4 presence sensing device is installed.

GuardShield Safe 4 safety light curtains must be properly installed by qualified personnel.

GuardShield Safe 4 safety light curtains are presence sensing devices and will not protect personnel from heat, chemicals, or flying parts. They are intended to signal a stop of hazardous machine motion when the sensing field is broken.

GuardShield Safe 4 safety light curtains can only be used on machinery which can be stopped anywhere in its stroke or cycle.

GuardShield Safe 4 safety light curtains should never be used on full revolution clutched machinery.

The effectiveness of the GuardShield Safe 4 safety light curtains depends upon the integrity of the machine control circuit. The machinery on which the GuardShield Safe 4 presence sensing device is installed should have control circuitry that is fail safe in design.

All stopping mechanisms for the machinery should be inspected regularly to ensure proper operation. The protected machinery must have a consistent reliable and repeatable stopping time.

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| **ATTENTION** | Failure to read and follow these instructions can lead to misapplication or misuse of the GuardShield Safe 4 safety light curtains, resulting in personal injury and damage to equipment. |

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This manual covers the operation and installation of the:

- GuardShield Safe 4 POC and PAC safety light curtains and
- GuardShield Safe 4 special configurations in the appendix

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| **IMPORTANT** | Save these instructions for use at a future time. |

Generally recognized technical regulations and quality assurance system ISO 9000 are carefully applied during the development and production of Allen-Bradley/ Guardmaster products.

This technical description must be followed when installing and commissioning the GuardShield Safe 4. Inspection and commissioning must be carried out by a qualified person.

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## Introduction

The GuardShield Safe 4 family of safety light curtains are general purpose presence sensing devices, designed for use on hazardous machinery providing point of operation (POC), as well as, perimeter access (PAC) detection.

It is a self-contained, two box, Type 4 ESPE (Electro Sensitive Protective Equipment).

The GuardShield Safe 4 is offered in a number of configurations based on a standard Type 4 safety light curtain platform.

In addition to the standard GuardShield Safe 4 POC and Safe4 PAC, the GuardShield Safe 4 are offered in special configurations described in the appendix at the back of these instructions.

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| **IMPORTANT** | These installation instructions are designed to address the technical personnel of the machine manufacturer and or the installer of the safety system regarding the proper mounting, configuration, electrical installation, commissioning, operation and maintenance of the GuardShield Safe 4 safety light curtain. These installation instructions do not provide instruction for the operation of machinery to which the GuardShield Safe 4 safety light curtain is, or will be, integrated. Only qualified personnel should install this equipment. |

## Safety Precautions

### Principles for Safe Use and Symbols Used

The following instructions are preventive warnings to ensure the safe and proper operation of the GuardShield Safe 4 light curtains. These instructions are an essential part of the safety precautions and therefore have to be observed at any time.

Throughout this manual we use the labels ATTENTION and IMPORTANT to alert you to the following:

**ATTENTION**

Failure to observe may result in dangerous operation

ATTENTION: Identifies information about practices of circumstances that can lead to personal injury or death, property damage, or economic loss.

ATTENTION helps you

- Identify a hazard
- Avoid a hazard
- Recognize the consequences

IMPORTANT: Identifies information that is especially important for successful application and understanding of the product.

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| **ATTENTION** | Potentially hazardous situation, which, if not prevented, might lead to serious or deadly injury.<br>Failure to observe may result in dangerous operation. |

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| **ATTENTION** | The GuardShield Safe 4 must not be used with machines that cannot be stopped electrically in an emergency.<br>The safety distance between the GuardShield Safe 4 and a dangerous machine movement has to be maintained at all times. |

Additional mechanical protective devices have to be installed in a way that hazardous machine elements cannot be reached without passing through the protective field.

The GuardShield Safe 4 has to be installed in a way that operators can only operate within the sensing area.

Improper installation can result in serious injury.

Never connect the outputs to +24V DC. If the outputs are connected to +24V DC, they are in ON-state and cannot stop hazardous spots at the machine/application.

Never expose the GuardShield Safe 4 to flammable or explosive gases.

Regular safety inspections are imperative (see maintenance).

Do not repair or modify the GuardShield Safe 4. The GuardShield Safe 4 safety light curtain is not field repairable and can only be repaired at the factory. Removal of either of the GuardShield Safe 4 endcaps will void the warranty terms of this product.

## Specialist Personnel

The GuardShield Safe 4 safety light curtain must be installed, commissioned and serviced only by a qualified person. A qualified person is defined as a person who:

- Has undergone the appropriate technical training

and

- Who has been instructed by the responsible machine operator in the operation of the machine and the currently valid safety guidelines

and

- Who has read and has ongoing access to these installation instructions

### Range of Uses of the Device

The GuardShield Safe 4 safety light curtain is classified as electro-sensitive protective equipment (ESPE). The physical resolution of the POC is 14 mm (0.55 in.) or 30 mm (1.18 in.). The maximum protective field width of GuardShield Safe 4 POC is:

- 0…9 m (29.5 ft) for the 14 mm (0.55 in.) resolution,
- 0…18 m (59.1 ft) for the 30 mm (1.18 in.) resolution
- 5…30 m (16.4…98.4 ft) for the 30 mm (1.18 in.) resolution

The protective field height is between 120 mm (4.7 in.) and 1920 mm (75.6 in.).

The maximum protective field width of GuardShield Safe 4 PAC (2, 3, and 4 beam) is 5…30 m (16.4…98.4 ft).

All standard GuardShield Safe 4 POC and PAC light curtains have Integrated Laser Alignment.

The device is a Type 4 ESPE as defined by IEC 61496-1 and CLC/TS 61496-2 and is therefore allowed for use with controls in safety category Type 4 in compliance with EN ISO 13849, SIL CL3 in accordance with EN62061 or up to PLe in accordance with EN ISO 13849. The device is suitable for:

- Point of operation protection (finger and hand protection)
- Hazardous area protection
- Access protection

Access to the hazardous point must be allowed only through the protective field. The machine/system is not allowed to start as long as personnel are within the hazardous area. Refer to the "Examples of Range of Use" on page 6 for an illustration of the protection modes.

Depending on the application, mechanical protection devices may be required in addition to the safety light curtain.

### Proper Use

The GuardShield Safe 4 safety light curtain must be used only as defined in the "Range of Uses of the Device." It must be used only by qualified personnel and only on the machine where it has been installed and initialized by qualified personnel.

If the device is used for any other purposes or modified in any way, warranty claims against Allen-Bradley/Guardmaster shall become null and void.

### General Protective Notes and Protective Measures

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|---|---|
| **IMPORTANT** | Safety Notes<br>Please observe the following items in order to ensure the proper and safe use of the GuardShield Safe 4 safety light curtain. |

The national/international rules and regulations apply to the installation, use and periodic technical inspections of the safety light curtain, in particular:

- Machine Directive 2006/42/EC
- Low Voltage Directive 2006/95/EC
- Use of Work Directive (2009/104/EC)
- The work safety regulations/safety rules
- Other relevant health and safety regulations

Manufacturers and users of the machine with which the safety light curtain is used are responsible for obtaining and observing all applicable safety regulations and rules.

The notices, in particular the test regulations of these installation instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.

The tests must be carried out by specialist personnel or specially qualified and authorized personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.

The installation instructions must be made available to the user of the machine where the GuardShield Safe 4 safety light curtain is installed. The machine operator is to be instructed in the use of the device by specialist personnel and must be instructed to read the installation instructions.

## Product Description

This section provides information on the special features and properties of the safety light curtain. It describes the structure and functions of the unit.

Please read this section before mounting, installing and commissioning the unit.

### Special Features

- Integrated laser alignment
- Large range with a compact profile
  14mm resolution: 0…9 m
  30mm resolution: 0…18 m or 5…30 m
- Tolerant to dust and pollution
- Short-circuit protected semiconductor outputs
- Built-in-diagnostic LEDs
- Optical synchronization, no electrical cable needed between transmitter and receiver
- Maintenance-free and cost effective

### Principles of Operation

The GuardShield Safe 4 safety light curtain consists of a non-matched pair of optic units, i.e., transmitter and receiver with the same protected height and resolution. The transmitter and receiver operate on +24V DC. The maximum distance between transmitter and receiver is referred to as the protective field width or range. The protective field height is the distance between the first and last beam in the device.

The transmitter emits sequential pulses of infrared light which are received and processed by the GuardShield Safe 4 receiver. The synchronization of the timing of the emission and reception of infrared light pulses is accomplished optically by the first beam adjacent to the GuardShield Safe 4 status LEDs. This beam is referred to as the synchronization beam. Because the GuardShield Safe 4 transmitter and receiver are optically synchronized, no electrical connection is required between the transmitter and receiver.

The GuardShield Safe 4 receiver has two safety outputs, Output Signal Switching Devices (OSSDs). When the GuardShield Safe 4 transmitter and receiver are properly powered and aligned, all OSSDs are current sourcing +24V DC with a switching capacity of 300 mA. The two safety OSSDs are cross monitored and short-circuit protected. Interruption of the sensing field causes the receiver to switch the sourced current OFF (0V DC).

Restoring the GuardShield Safe 4 sensing field causes all outputs (OSSDs) to switch to the active high state (resume current sourcing +24V DC with a switching capacity of 300 mA).

GuardShield Safe 4 operates in the guard only mode with automatic restart. Other modes of operation e.g. PSDI mode (break mode), muting, external relay monitoring (EDM) can be realized using external safety devices.

The GuardShield Safe 4 safety light curtain consists of a transmitter and a receiver.

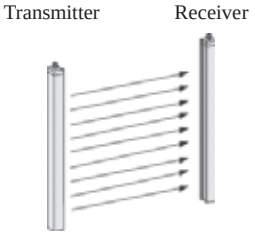


*Figure 1: Components of the GuardShield Safe 4*

The protective field and the active elements respectively, are clearly recognized as black surfaces with the integrated optical lenses.

The width of the protective field is derived from the length of the light path between sender and receiver and must not exceed the maximum rated width of the protective field

- (0…9 m (22.9 ft) for 14 mm (0.55 in.) resolution, or
- 0…18 m (59.1 ft) for 30 mm (1.18 in.) resolution, or
- 5…30 m (16.4…98.4 ft) for 30 mm (1.18 in.) resolution.

## Perimeter Systems (PAC)

Perimeter systems are usually produced by means of several single-beam light barriers. But the flexibility of the GuardShield Safe 4 system allows also the production of vertical entry safeguarding according to the standard EN ISO 13855 [2010]. Such systems are composed of active and passive elements in one compact profile. The element length of each is 120 mm (variations are given in the appendix).

The protective field and the active elements respectively, are clearly recognized as black surfaces with the integrated optical lenses. The areas not monitored (passive elements) are also clearly indicated as yellow surfaces.

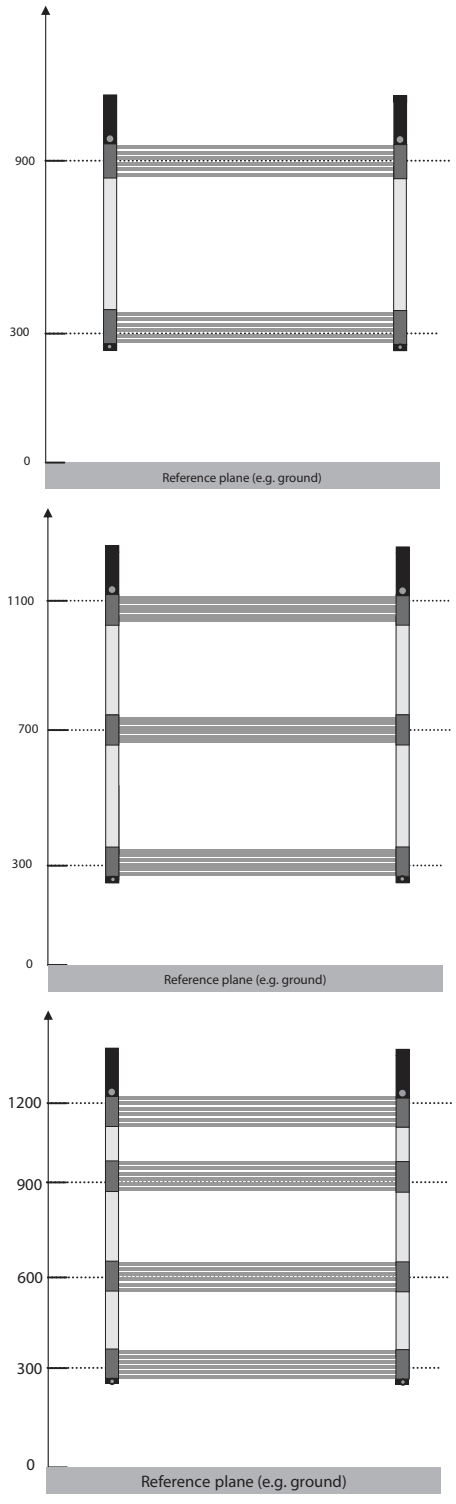


*Figure 2: Perimeter systems (2-, 3-, and 4-beams) according to EN ISO 13855 (2010)*

## Examples of Range of Use

The GuardShield Safe 4 safety light curtain operates as a proper protective device only if the following conditions are met:

- The control of the machine must be electrical.
- The controlled machine must be able to be stopped any where in the machines stroke or cycle.
- The transmitter and receiver must be mounted such that access to the hazard is only through the light curtain's protective field.
- The restart button must be located outside the hazardous area such that it cannot be operated by a person working inside the hazardous area.
- The statutory and local rules and regulations must be observed when installing and using the device.

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| **IMPORTANT** | Additional measures may be necessary to ensure that the ESPE does not fail to danger when other forms of light radiation are present in a particular application (i.e., use of cableless control devices on cranes, radiation from weld spatter or effects from strobe lights). |

#### GuardShield Safe 4 Laser Alignment

The laser light source in the Integrated Laser Alignment system of the GuardShield Safe 4 light curtains is a Class 2, eye safe laser diode with a wavelength of 630 nm.

This Class 2, eye safe laser is switched from a low output power state to a high output power state (and back again) by means of control circuitry which detects reflected laser light from a temporary blockage of the emitted laser light. This is most commonly accomplished by a person's finger placed over the laser overlay window. There is also an automatic shutdown feature that switches the laser diode from the high power state to the low power state if there is no finger or other interruption detected for a period of five minutes.

During the high output mode of operation, the laser is pulsed at a rate of approximately 2 Hz in order to facilitate finger detection in high ambient light conditions.

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|---|---|
| **Class 2 Laser** | To prevent exposure to laser radiation, do not expose your eyes to the laser. Turn ILAS off if not in use. |

## Safety Functions

All GuardShield Safe 4 safety light curtains operated as on/off devices, meaning the OSSD outputs switch off/on according to an obstruction or clearing of the detection field.

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| **IMPORTANT** | The protective system must be tested for proper operation after each and every change to the configuration. |

#### System Testing

The GuardShield Safe 4 performs a complete system self-test at power up and switches to the ON state if the system is properly aligned and the protective field is unobstructed.

#### External Test (Machine Test Signal)

Normally the test input at the transmitter is installed with a short-circuit jumper to activate the transmitter. A test cycle of the system can be triggered by an external test signal to the GuardShield Safe 4 transmitter. Supplying or removing a signal (+24V DC) via a N.C. or N.O. switch at the test input deactivates the transmitter for the duration of the test signal, simulating an interruption of the protective sensing field (see also page 11).

#### Response Time

The response time of the GuardShield Safe 4 safety light curtain depends on the height of the protective field, the resolution, and the number of light beams (see table on page 20).

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| **IMPORTANT** | Determining Stop Time: The measurement of stopping time (Ts) must include the stopping times of all devices in the stop circuit. Not including all device and control system elements when calculating Ts will result in an inaccurate safety distance calculation. |

# Determining the Safety Distance

The light curtain must be mounted with proper safety distance

- From the point of danger
- From reflecting surfaces

## US Safety Distance Formula

| | |
|---|---|
| **ATTENTION** | The GuardShield Safe 4 safety light curtains must be mounted at a sufficient distance from the pinch point or point of operation hazard to help ensure that the machine stops before a person's finger, hand, arm(s), or body reaches the hazard. |

This distance, referred to as the safety distance, must be properly calculated prior to determining the safety light curtain protective height and mounting the light curtains on the machine. Failure to properly calculate this safety distance may result in operator injury.

| | |
|---|---|
| **IMPORTANT** | Regardless of the calculated safety distance, GuardShield Safe 4 safety light curtains should never be mounted closer than six inches from the point of operation or pinch point hazard. |

In the United States there are two formulas that are used to properly calculate the safety distance. The first, the OSHA formula, is the minimum requirement for the calculation of the safety distance. The second formula, the one recommended by Rockwell

Automation, is the ANSI formula, which incorporates additional factors to be considered when calculating the safety distance.

## OSHA Safety Distance Calculation Formula

The OSHA safety distance formula as specified in CFR Subpart O 1910.217 is as follows:

$Ds = 63 \times T_S$

Ds Safety Distance in inches

63 Is the OSHA recommended hand speed constant in inches per second

Ts Is the total stop time of all devices in the safety circuit, measured in seconds. This value must include all components involved in stopping the hazardous motion of the machinery. For a mechanical power press it is the stopping time measured at approximately the 90° position of the crankshaft rotation.

The $T_S$ number must include the response times of all devices, including the response time of the safety light curtain, the safety light curtain controller (if used), the machine's control circuit and any other devices that react to stop the hazardous motion of the machinery. Not including the response time of a device or devices in the stop time calculation will result in insufficient safety distance for the application. This may result in operator injury.

## The ANSI Safety Distance Formula

The ANSI safety distance formula, which is the Rockwell Automation recommended formula, is as follows:

$D_S = K \times (T_S + T_C + T_r + T_{bm}) + D_{pf}$

Ds Minimum safety distance between the safe guarding device and the nearest point of operation hazard, in inches.

K Hand speed constant in inches per second. The ANSI standard value is 63 inches per second when the operator begins reaching toward the point of operation hazard from rest. NOTE: ANSI B11.19 1990 E4.2.3.3.5 states "The value of the hand speed constant, K, has been determined by various studies and although these studies indicate speeds of 63 inches/second to over 100 inches/second, they are not conclusive determinations. The employer should consider all factors, including the physical ability of the operator, when determining the value of K to be used."

Ts Stop time of the machine tool measured at the final control element.

Tc Response time of the control system

$T_s$ and $T_c$ are usually measured by a stop time measuring device.

Tr Response time of the presence sensing device (safety light curtain) and its interface, if any. This value is generally stated by the device manufacturer or it can be measured by the user.

Tbm Additional time allowed for the brake monitor to compensate for variations in normal stopping time.

Dpf Depth penetration factor. It is an added distance to allow for how far into the protective field an object, such as a finger or hand, can travel before being detected. $D_{pf}$ is related to the object sensitivity of the safety light curtain. Object sensitivity is the smallest diameter object which will always be detected anywhere in the sensing field.

Example:

In opto-electronic safeguarding, such as with a perpendicular safety light curtain applications with object sensitivity (effective resolution) less than 2.5 inches, the $D_{pf}$ can be approximated based on the following formula:

$D_{pf}$ (inches) = $3.4 \times$ (Object Sensitivity – 0.276), but not less than 0.

## European Safety Distance Formula

A safety distance must be maintained between the light curtain and the point of danger. This safety distance ensures that the point of danger can only be reached after the dangerous state of the machine has been completely removed.

The safety distance as defined in EN ISO 13855 and EN ISO 13857 depends on:

- Stopping/run-down time of the machine or system. (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the protective device, e.g. GuardShield Safe 4 (for "Response Time" see page 6).
- Reach or approach speed.
- Resolution of the light curtain and/or beam separation.

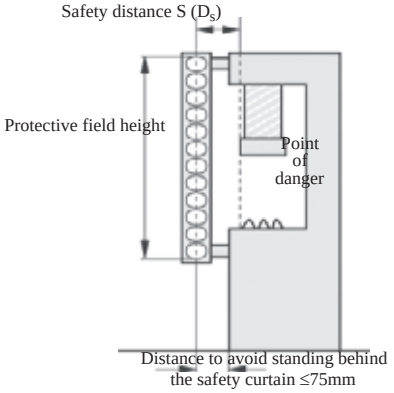
Safety distance S (Ds)
Protective field height
Point of danger
Distance to avoid standing behind the safety curtain ≤75mm

*Figure 3: Safety distance from the point of danger*

**How to Calculate the Safety Distance S for GuardShield Safe 4 Systems with a resolution ≤40 mm. According to EN ISO 13855 and EN ISO 13857:**

-> First, calculate S using the following formula:
$S = 2000 \times T + 8 \times (d - 14)$ [mm]

Where …

T = stopping/run-down time of the machine + response time of the protective device [s]

d = resolution of the light curtain [mm]
S = safety distance [mm]
The reach/approach speed is already included in the formula.

-> If the result S is ≤ 500 mm (19.6 in.), then use the determined value as the safety distance.

-> If the result S is > 500 mm (19.6 in.), then recalculate S as follows: S = 1600 × T + 8 × (d – 14) [mm]

-> If the new value S is > 500 mm (19.6 in.), then use the newly determined value as the minimum safety distance.

-> If the new value S is ≤ 500 mm (19.6 in.), then use 500 mm (19.6 in.) as the safety distance.

Example:

Stopping/run-down time of the machine = 290 ms
Response time = 30 ms
Resolution of the light curtain = 14 mm (0.55 in.)
T = 290 ms + 30 ms = 320 ms = 0.32 s
S = 2000 × 0.32 + 8 × (14 – 14) = 640 mm (25.1 in.)
S > 500 mm, therefore:
S = 1600 × 0.32 + 8 × (14 – 14) = 512 mm (20.1 in.)

#### How to Calculate the Safety Distance S for GuardShield Safe 4 PAC Systems

In the case of perimeter systems or light curtains with a resolution d > 40 mm, the safety distance is calculated for vertical mounting light curtains and horizontal approach, according to the formula:

S = 1.6 mm/ms x T + 850 mm

More detailed information regarding safety distance and safety heights can be found in standard EN 13855 (2010).

#### Minimum Distance from Reflecting Surfaces

The infrared light from the sender may be reflected off of shiny surfaces and be received by the system's receiver. If this condition occurs, it can result in an object not being detected when it enters the GuardShield Safe 4 sensing field.

All reflecting surfaces and objects (e.g. material bins) must therefore be located at a minimum distance a from the protective field of the system. The minimum distance a depends on the distance D between sender and receiver.

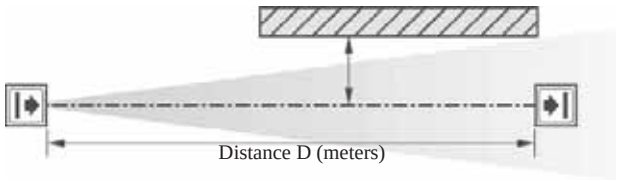


*Figure 4: Minimum distance from reflecting surfaces*

#### How to Determine the Minimum Distance from the Reflecting Surfaces:

- Determine the distance D [m] sender-receiver
- Read the minimum distance a [mm] from the graph:

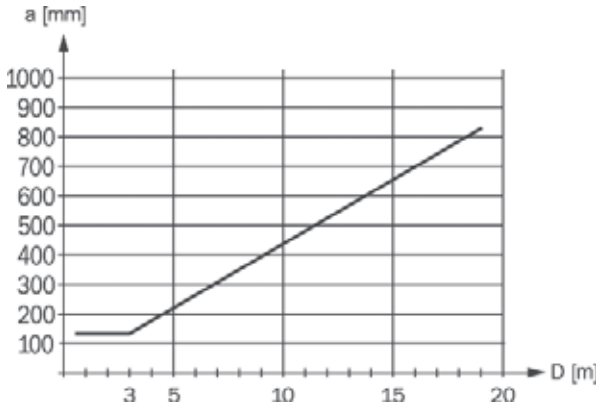


*Figure 5: Graph, minimum distance from reflecting surfaces*

The effective aperture angle for the GuardShield Safe 4 system is ±2.5° at a mounting distance of > 3.0 m (9.8 ft). Calculate the minimum distance to reflecting surfaces depending on the distance between the transmitter and the receiver, using an aperture angle of ±2.5°, or take the appropriate value from the following table:

| Distance Between Transmitter and Receiver (Range D) [m (ft)] | Minimum Distance a [mm (in.)] |
|---|---|
| 0…3.0 (0…9.8) | 135 (5.31) |
| 4.0 (13.1) | 175 (6.88) |
| 5.0 (16.4) | 220 (8.66) |
| 6.0 (19.6) | 265 (10.43) |
| 7.0 (22.9) | 310 (12.2) |
| 10.0 (32.8) | 440 (17.32) |
| 16.0 (52.4) | 700 (27.55) |

Formula: a = tan 2.5° x D [mm]

a = minimum distance to reflecting surfaces
D = distance between transmitter and receiver

## Installation and Mounting

This section describes the preparation, selection and installation of the GuardShield Safe 4 safety light curtain. Mount and connect both transmitter and receiver.

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| **IMPORTANT** | The installation of the GuardShield Safe 4 safety light curtain must be such that access to the hazard is only possible through the sensing field of the GuardShield Safe 4. Auxiliary safe guarding may be required in conjunction with the GuardShield Safe 4 to meet this requirement. |

Determine if the machinery, on which the GuardShield Safe 4 is to be mounted, meets the requirements as specified in the beginning of this manual, i.e., machinery must be able to be

stopped anywhere in its stroke or cycle, consistently and repeatedly.

## Alignment Procedure

### Standard GuardShield Safe 4

The GuardShield Safe 4 is offered with an integrated laser alignment system which has a constantly powered Class 2, eye safe laser located in the bottom of the GuardShield Safe 4 transmitter and in the top of the GuardShield Safe 4 receiver. Each laser emits a low level of visible light. Simply blocking this light below the finger symbol causes the light to be reflected back to a photo sensor which changes the condition of the laser light. If this light is at a low level, interrupting it will cause the laser to emit a highly visible level of light. Interrupting the visible light in the same location will cause the laser to switch to a low level of emission. The emission of visible light will also change to a low level after five minutes of activation.

### GuardShield Safe 4 with Integrated Laser Alignment

Cycle power to assure that the system powers up and goes to the ON state.

1. Properly locate the GuardShield Safe 4 pair from the point of operation hazard after performing the safety distance calculation.
2. Using the GuardShield Safe 4 mounting brackets, mount the transmitter and receiver so that they are facing one another and are positioned in the same direction. A reference would be that the indicator LEDs are opposite one another. They must be parallel to each other and be positioned at the same height. Turn on power to GuardShield Safe 4 system.

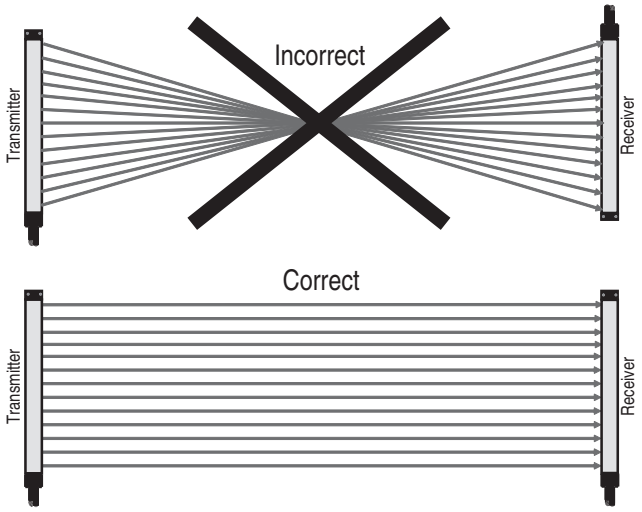



*Figure 6: Layout of the transmitter/receiver*

3. Turn on each laser by placing a finger or hand in front of each laser (close to the finger symbol ☞).
4. For optimal alignment, adjust the transmitter and receiver in such a way that both visible laser beams hit the laser targets opposite each laser. A small deviation around the target is allowable and are harmless as long as they are within the aperture angle.
5. Tighten all screws firmly.
6. Switch the ILAS off when aligned.

When mounting Perimeter Systems adjust the heights according to the recommendations in the local standards and regulations (Europe: EN ISO 13855 [2010]) (see Figure 2).

The GuardShield Safe 4 safety light curtain is suitable for most operating environments (IP65 environmental rating). Proper safety distance as well as adequate protective height must be observed.

### Remarks to ILAS

Due to dimensional tolerances the visible ILAS laser beam may be located "off center" from the target when the light curtain is aligned optimally in the center of the operating range. The optimal operating point can be found after alignment with ILAS when moving the axis in X- (left, right) and Z- (up, down) direction. The optimal operating point is in the middle of the two end points, where the receiver output switches from active to inactive condition.

On optimal alignment of the light curtain, the ILAS light point can deflect from the ILAS target point. The maximum deflection adds up to the following value due to the operating distance:

| | | |
|---|---|---|
| 2 m | R = 7 mm | D = 7 mm |
| 6 m | R = 20 mm | D = 21 mm |
| 9 m | R = 30 mm | D = 32 mm |
| 18 m | R = 60 mm | D = 63 mm |
| 30 m | R = 99 mm | D = 105 mm |

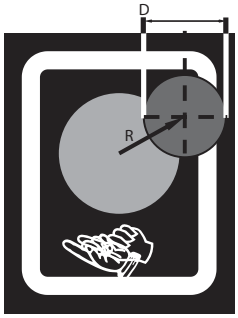


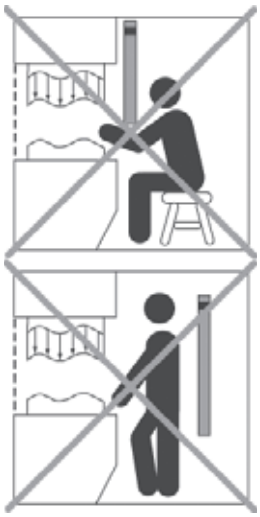

*Figure 7: Adjustment with ILAS*

## Correct Installation

Operators cannot reach hazardous machine parts without passing through the protective field.

Operators must not step between protective field and hazardous machine parts (by-pass prevention).

## Incorrect Installation



Operators can reach hazardous machine parts without passing through the protective field.

Operators can step between protective field and hazardous machine parts.

The GuardShield Safe 4 must be mounted at the proper distance from the point of operation hazard. This distance is referred to as the Safety Distance.

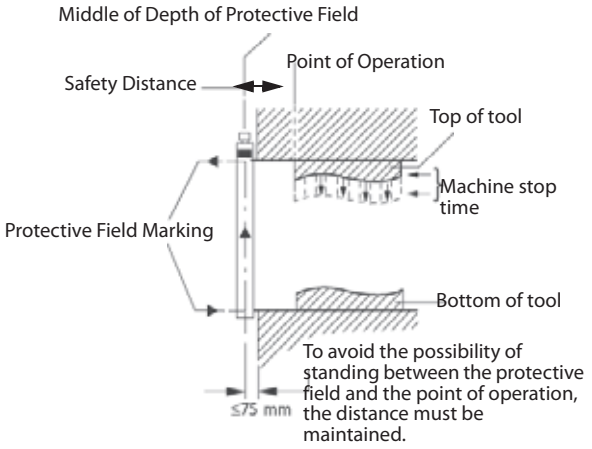

Middle of Depth of Protective Field
Point of Operation
Safety Distance
Top of tool
Machine stop time
Protective Field Marking
Bottom of tool
To avoid the possibility of standing between the protective field and the point of operation, the distance must be maintained.
≤75 mm

*Figure 8: Determining machine stopping time and safety distance*

After installation and alignment of the GuardShield Safe 4 safety light curtain, the protection field has to be tested with the test rod for the corresponding resolution (14 or 30 mm) according to Figure 9.

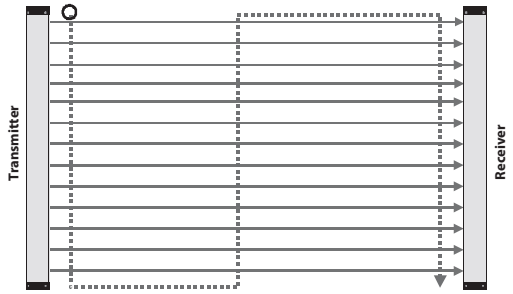


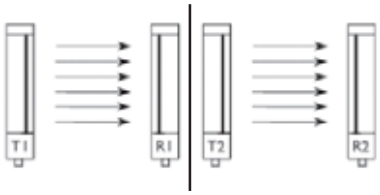

*Figure 9: Correct testing of the protective field using a test rod*

## Multiple GuardShield Safe 4

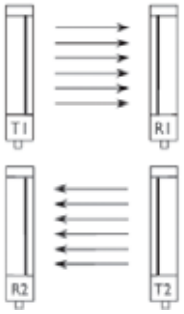
When two or more GuardShield Safe 4s are mounted in close proximity to one another, it may be possible for the receiver of one GuardShield Safe 4 pair to receive infrared light from the transmitter of another GuardShield Safe 4 pair.

There are various techniques to prevent or eliminate the possibility of optical interference from GuardShield Safe 4 light curtains mounted in the same plane. The simplest method is to alternate transmitter and receiver pairs so that the receiver from a second pair is facing away from the transmitter of another GuardShield Safe 4 pair in close proximity. It is also possible to place a physical barrier between pairs to prevent the infrared light from reaching another GuardShield Safe 4 pair.

Transmitters emit in opposite direction. Each receiver receives only the beams of the appropriate transmitter.




Transmitters emit in same direction:
Optical (physical) barrier necessary

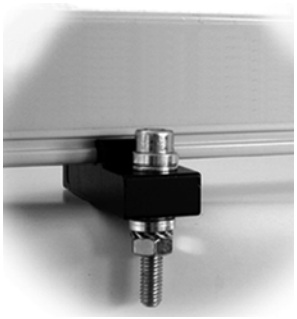


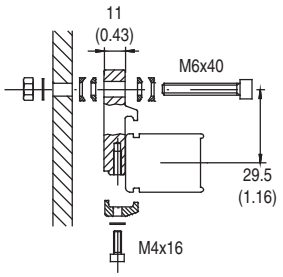

Positioning of the light curtain: Transmitters emit in opposite direction.

*Figure 10: Multiple GuardShield Safe 4 alignment options*

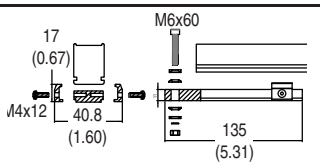
## Mounting Brackets

The GuardShield Safe 4 is mounted using brackets which attach to the side of both transmitter and receiver. It may be necessary to use additional brackets to mount the GuardShield Safe 4 at a proper safety distance from the machinery hazard.

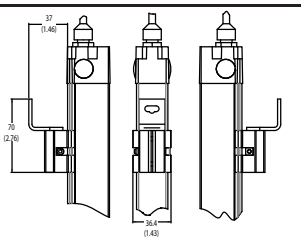





445L-AF6140
Standard mounting brackets—supplied with each light curtain
For side mounting
Adjustable by ± 4°
(Two brackets per kit.)




445L-AF6144
Vertical mounting brackets (optional)
For mounting in the vertical axis of the light curtain
Adjustable by ± 4°
(Two brackets per kit.)



445L-AF6141
180° Mounting, rotation ±90°, for applications where the mounting angle is not set using the mounting frame.
(Two brackets per kit.)

*Figure 11: Different mounting brackets for Safe 4*

### Safe 4 Shock Mounting Kit

Rockwell Automation offers a shock and vibration isolation kit for vertically mounting the Safe 4. This kit is most effective in protecting the internal optical and electronic components of the Safe 4 light curtain. The best performance of the shock and vibration isolation kit is attained when the kit is used in conjunction with the Safe 4 vertical mounting brackets (445L-AF6144).

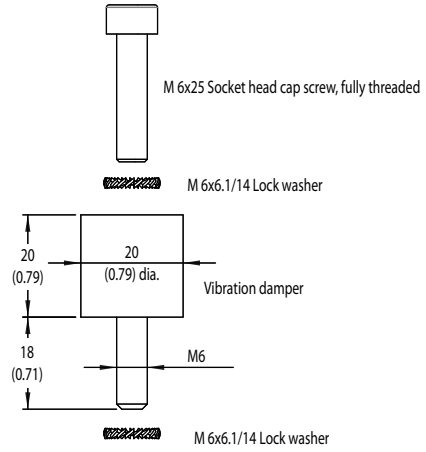



*Figure 12: Shock Isolator*

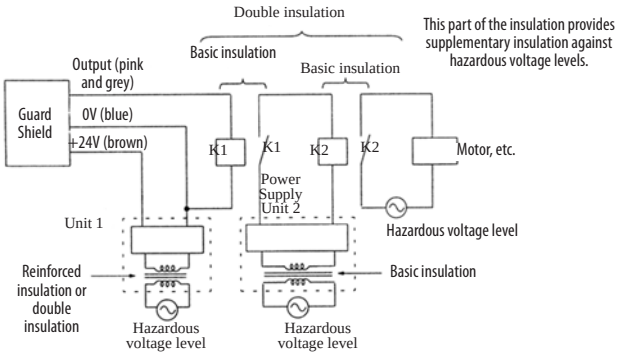
## Electrical Installation

### Connections

#### Power Supply

The external voltage supply (+24V DC) must meet the requirements of IEC 61496-1. In addition, the following requirements have to be fulfilled:

- A short-term power failure of 20 ms must be bridged by the power supply.
- The power supply has double insulation between the primary and the secondary side.
- The power supply is protected against overload.
- The power supply corresponds to the guidelines of the EWG (industrial environment).
- The power supply corresponds to the Low Voltage Directives.
- The grounded conductor of the power supply device must be connected to a grounded conductor PE.
- The maximum deviation of the voltage levels is 24V DC +/- 20%.



### Cables/Connectors

The GuardShield Safe 4 transmitter and receiver connectors are 5-pin M12 quick-disconnect connectors. Shielded and nonshielded cordsets are offered in lengths from 2 to 30 meters.

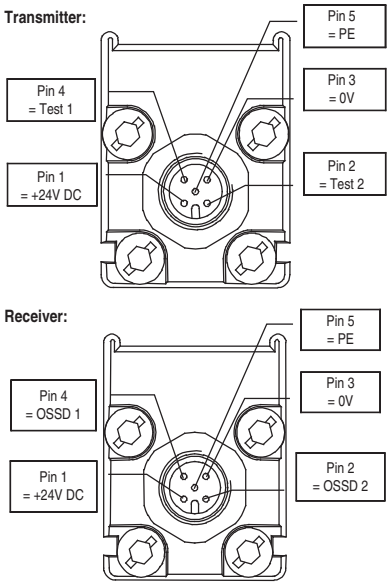



*Figure 13: Pin assignment of the M12 connectors*

### M12 Connector Dimensions [mm (in.)]

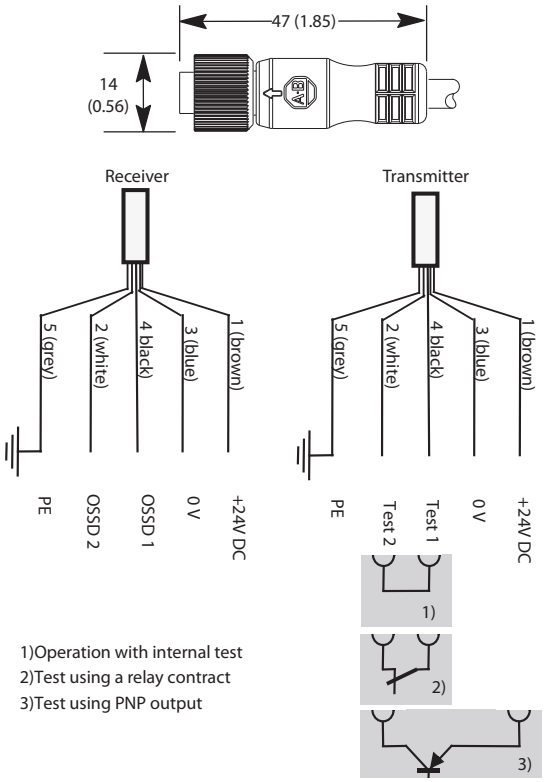
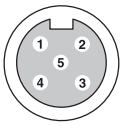
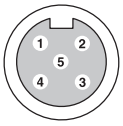



*Figure 14: Five-pin female connection for Safe 4*

| Female Top View | Color | Pin No. | Signal Receiver |
|---|---|---|---|
|  | Brown | 1 | +24V |
| | White | 2 | OSSD 2 |
| | Blue | 3 | 0V |
| | Black | 4 | OSSD 1 |
| | Grey | 5 | Ground (PE) |

*GuardShield Safe 4 Receiver Connector pin assignments and wire colors*

| Female Top View | Color | Pin No. | Signal Receiver |
|---|---|---|---|
|  | Brown | 1 | +24V |
| | White | 2 | Test 2 |
| | Blue | 3 | 0V |
| | Black | 4 | Test 1 |
| | Grey | 5 | Ground (PE) |

*GuardShield Safe 4 Transmitter Connector pin assignments and wire colors*

### Test input to transmitter

Normally the test input at the transmitter is installed with a short circuit jumper to activate the transmitter. If an external test is desired, a contact can be connected to the test input).

The timing of test input is as follows (Figure 14):

| | Time | Value in ms |
|---|---|---|
| Response time on test signal | $t_1$ | $\leq t_R + 15$ |
| Time to test | $t_2$ | $> t_1$ |
| Restart time after test | $t_3$ | $\leq 800$ |

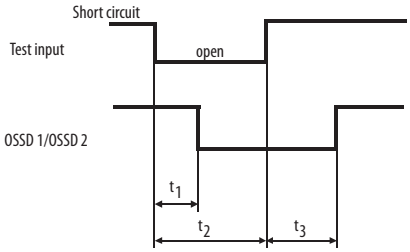



*Figure 15: Test timing diagram*

$t_R$ means the response time of the respective Safe 4 type (see product label).

| Internal test | Description | Value |
|---|---|---|
| Continuous test current | I | 10 mA |
| Peak test current | $I_P$ | 100 mA |
| Time of peak test current | $t_P$ | 20 µs |

| Internal test | Transmitter | Test LED Transmitter |
|---|---|---|
| Short circuited (closed) | Active | Green |
| Open | Inactive | Red |

### Bringing into operation

After the power  has been applied to the GuardShield Safe4 and the automatic power-up test is successfully completed, the green Power LED on the receiver and transmitter will light on. The system is now ready to operate.

The automatic power-up test will only be successful, if transmitter and receiver are properly aligned, correctly connected and the protective field is not interrupted.

Any intrusion of an object into the protective field will switch the OSSD off within the specified response time and the LED at the receiver toggles from green to red.

### Outputs

The two redundant Output Signal Switching Devices (OSSD) are fully monitored. Any short circuits are detected. The maximum load is 0.3 A, higher currents are limited through short circuit protection. Increased output loads may be realized using external safety interfaces.

The output voltage at the solid-state outputs is dependant on the power supply and the output load.

### Typical wiring diagram to MSR127 safety relay module

The interfacing of the light curtain with the machine control has to be control reliability, i.e. a correct interface with a safety PLC or safety relays with positive guided relay contacts.

| | |
|---|---|
| **ATTENTION** | The safety devices and the interconnection to the machinery have to comply with the basic safety requirements as mentioned in the current regulations and standards.<br>Direct interfacing of a safety light curtain to machine control that does not meet the necessary safety integrity level, i.e., use of general purpose PLCs or general purpose relays may cause injury to persons.<br>Consult a professional safety engineer. |

## Typical Wiring Diagrams—Safe 4 or Safe 4 PAC

### Connection with Guardmaster SI Safety Relay

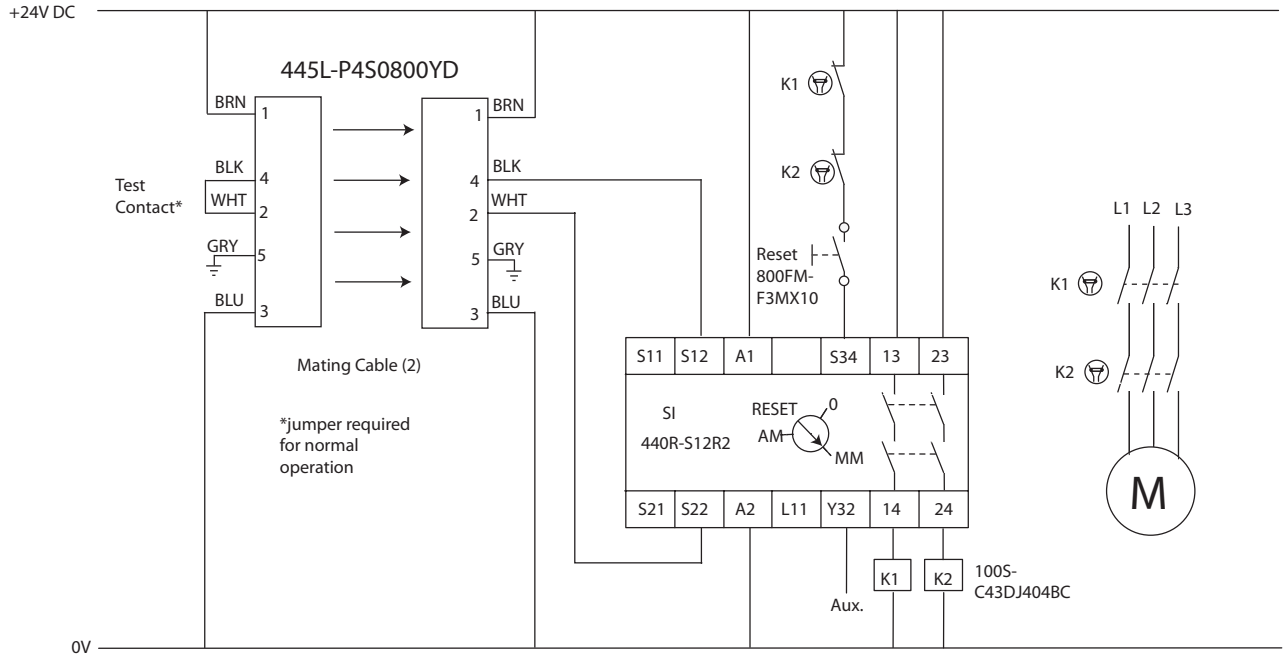



*Figure 16: Safe 4 to Guardmaster SI safety relay, manual reset*

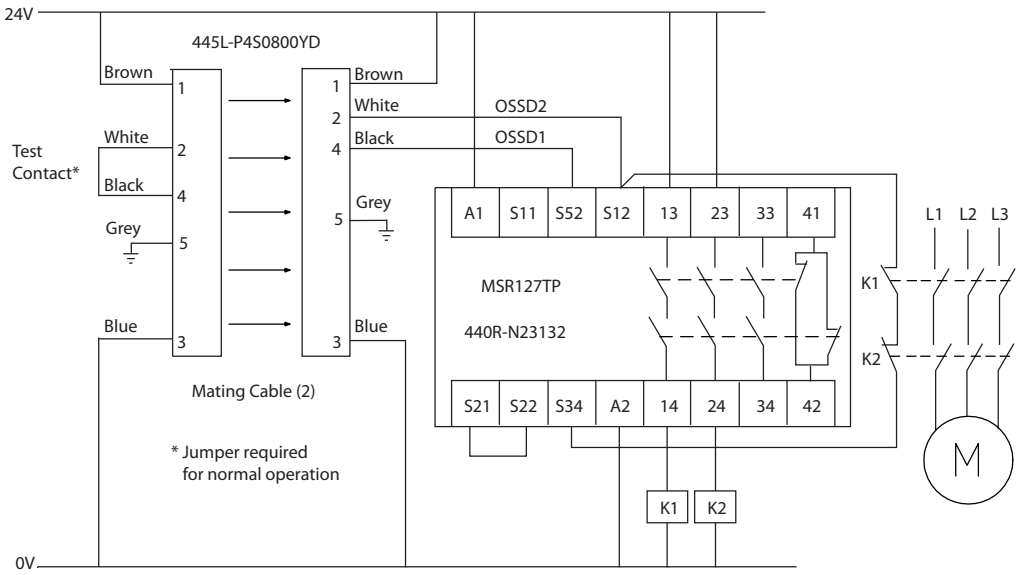



*Figure 17: Safe 4 or Safe 4 PAC for manual reset mode using MSR127TP safety relay module*

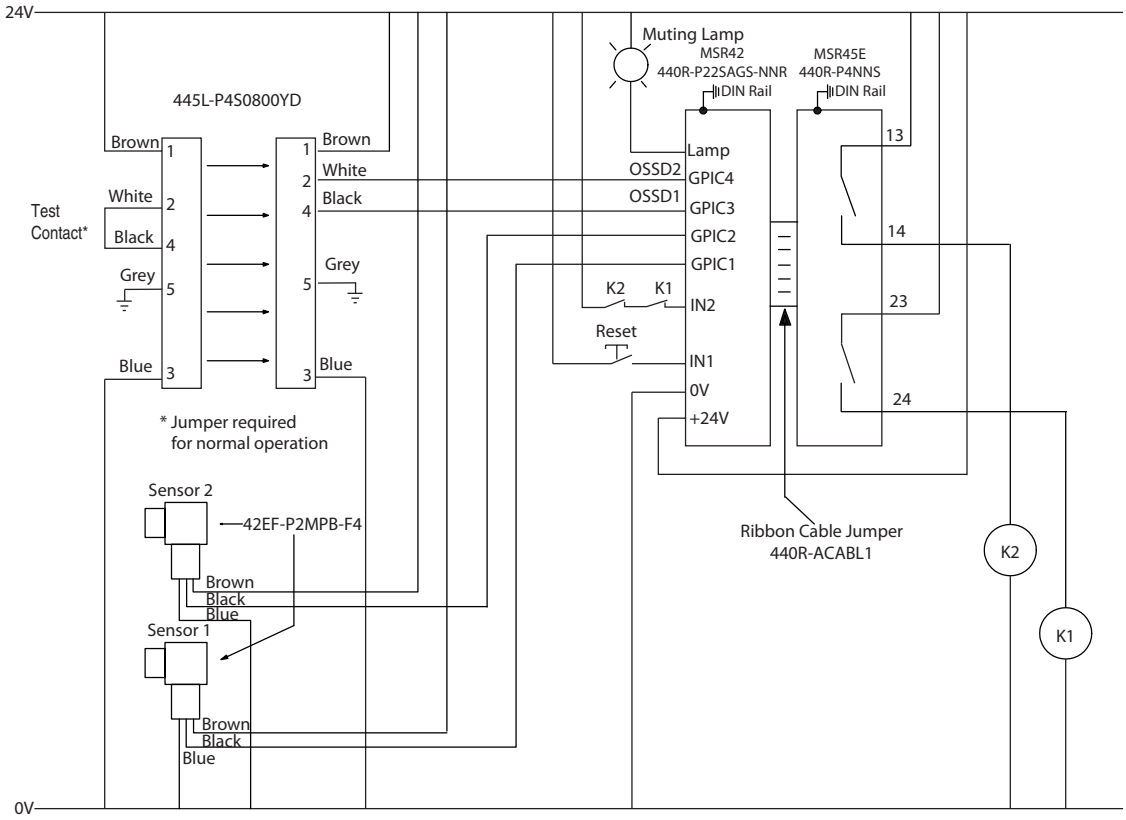



*Figure 18: Safe 4 or Safe 4 PAC for two sensor muting using MSR42 multi-function safety module and MSR45E safety relay expansion module*

## Troubleshooting Guide

The light curtain carries out an internal self-test after startup. If an error occurs, an appropriate signal combination is indicated by the LEDs of the transmitter or the receiver.

**ATTENTION**

Assure that all power to the machine, and safety system is disconnected during electrical installation.

### System Status Indicators

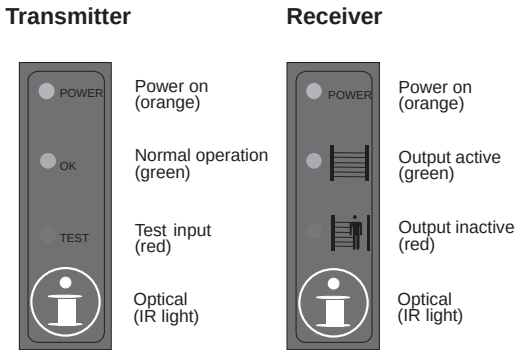



*Figure 19: LED indicators*

Possible errors and operation status are indicated with the LED indicators on the transmitter and receiver.

The following combinations are relevant:

| Status | Orange (Power) | LEDs | |
|---|---|---|---|
| | | Green (ok) | Red (Test) |
| No power supply (external) | off | off | off |
| Test input closed (external) | on | on | off |
| Test input open (external) | on | off | on |
| Controller error (internal) | flashing | off | on |
| Protective field error (internal) | flashing | off | on |

*Table 1: Transmitter*

| Status | Orange (Power) | LED | |
|---|---|---|---|
| | | Green (Protective field not interrupted) | Red (Protective field interrupted) |
| No power supply (external) | off | off | off |
| No sufficient power (external) | on | off | off |
| OSSD on (on-load operation, protective field not interrupted, normal) | on | on | on |
| OSSD off (off-load operation, protective field interrupted or insufficient alignment of the system) | flashing | off | on |
| OSSD error (external, short circuit between OSSD 1 and OSSD 2, towards 0 V or 24V DC) | all 3s short time | off | flashing |
| Controller error (internal) | irregular flashing | off | on |
| Protective field error (internal) | flashing | off | flashing |

*Table 2: Receiver*

External error: An external interface error can be resolved by correcting the installation, due to

1. Receiver: short circuit of both OSSDs, of OSSD to $U_{sp,}$ or of OSSD to GND
2. Transmitter: Test input open
3. No power or power supply too low
4. Inadequate adjustment of transmitter and receiver

Internal error (orange Power LED is irregularly flashing): Exchange Component

| Normal operation | | |
|---|---|---|
| Transmitter | Receiver | Operation status |
| Test input closed<br>closed | OSSD on<br>OSSD off | Protective field free<br>Protective field interrupted |
| Test input open | OSSD off | Test active |

| | |
|---|---|
| **IMPORTANT** | Prior to powering up the GuardShield Safe 4 system, the responsible person should review the following checklist. |

### Checklist

Before the initiation of the GuardShield Safe 4 the responsible person should work through the following checklist.

Cable check prior to initiation:

| | |
|---|---|
| 1. | The power supply is solely connected to the GuardShield Safe 4. |
| 2. | The power supply is a 24V DC device, that must comply to all applicable standards of the Machinery Directive 2006/42/EC, and the product standard (IEC 61496). |
| 3. | Proper polarity of the power supply at the GuardShield Safe 4. |
| 4. | The transmitter connection cable is properly connected to the transmitter, the receiver connection cable is properly connected to the receiver. |
| 5. | The double insulation between the light curtain output and an external potential is ensured. |
| 6. | The OSSD outputs are not connected to +24V DC or 0V. |
| 7. | The connected switching elements (load) are not connected to 24V DC. |
| 8. | For a self testing safety light curtain system , the test output and input of the transmitter are short circuited. |
| 9. | No connection to a conventional power supply. |
| 10. | If two or more GuardShield Safe 4 are to be used, make sure that each system is properly installed, in order to avoid optical interference. |

Switch the GuardShield Safe 4 on and check its function by observing the following:

Two seconds after switching on, the system starts to work properly if the protection field is free of obstructions

## Safety Instructions—Maintenance

| | |
|---|---|
| **ATTENTION** | Never operate the GuardShield Safe 4 before carrying out the following inspection. Improper inspection may lead to serious injury. |

Note:

1. For safety reasons all inspection results should be recorded.
2. Only persons, who clearly understand the functioning of the GuardShield Safe 4 and of the machine, may carry out an inspection.
3. If installer, planning engineer and operator are different people, make sure that the user has sufficient information available to carry out the inspection.

### Daily Inspection

| | |
|---|---|
| 1. | Approach to hazardous machine parts must only be possible by passage through the protective field of GuardShield Safe 4. |
| 2. | Operators cannot step through the sensing area while working on dangerous machine parts. |
| 3. | The safety distance of the application is bigger than the calculated value. |
| 4. | The optic front cover is neither scratched nor dirty. |

Operate the machine and check, if the hazardous movement will stop under the following circumstances.

| | |
|---|---|
| 5. | The protective field is interrupted. |
| 6. | Hazardous machine movement stops immediately, if the protective field is interrupted by the test rod directly in front of the transmitter, directly in front of the receiver and in the middle between transmitter and receiver. |
| 7. | No hazardous machine movement while the test rod is anywhere within the protective field. |
| 8. | The power supply of the GuardShield Safe 4 is turned off. |
| 9. | If the blanking function is activated, check all sections of the protective field with the appropriate test piece. |

| | |
|---|---|
| **IMPORTANT** | If any of the above conditions do not result in the hazardous motion of the machine ceasing, do not allow the protected machine to be placed in operation. |

### Six-Month Inspection

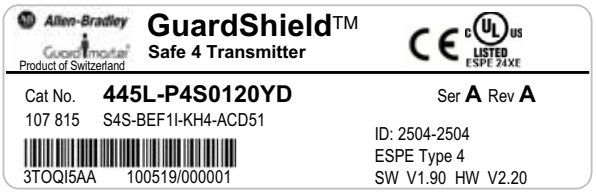
Check the following items every six months or whenever a machine setting was changed.

| | |
|---|---|
| 1. | Machine stops or does not obstruct any safety function. |
| 2. | The latest machine or connection modifications have no effect on the control system. |
| 3. | The outputs of the GuardShield Safe 4 are properly connected to the machine. |
| 4. | The total response time of the machine is shorter than the calculated value. |
| 5. | Cables and plugs of the GuardShield Safe 4 are in good condition. |
| 6. | Mounting brackets, caps and cables are tightly secured. |

## Cleaning

If the optic front cover of the GuardShield Safe 4 is dirty, the outputs of the GuardShield Safe 4 turn off. Take a clean, soft cloth and rub without pressure. Do not apply aggressive, abrasive or scratching cleansing agents, which might attack the surface.

## Date Code and Label




AABCCDEE

AA = Production place (AL=Mexico, 3T= Switzerland)

B = Year

CC = Day (LA = 001, LB = 002, …)

D = Internal RA product code

- 4 = GS Safe4 System
- 5 = GS Safe4 Tx
- 6 = GS Safe4 Rx

EE = Counter (AA=001, AB=002, …)

Example: 3T0QI5AA:

AA = 3T = Produced in Switzerland

B = 0 = Year 2010

CC = QI = Day 138 = 19 May

D = 5 = Transmitter

EE = AA = 001

## Technical Specifications

| | |
|---|---|
| Light Beams | Min 8 - Max 256 |
| Protective Field | 120…1920 mm (4.7…75.6 in.) in 120 mm (4.7 in.) increments for Standard GuardShield Safe 4; |
| Resolution | 14 mm (0.55 in.), 30 mm (1.18 in.) |
| Range | 14 mm (0.55 in.); 0…9.0 m (0…29.5 ft),<br>30 mm (1.18 in.); 0…18.0 m (0…59.0 ft)<br>30 mm (1.18 in.); 5…30.0 m (16.4…98.4 ft)<br>PAC: 2, 3, 4 beams: 5…30.0 m (16.4…98.4 ft) |
| Response Time | OSSD – ON to OFF: (Reaction times); see tables on pages 20 and 21 |
| Power Supply | 24V DC ±20%; Power supply must meet the requirements of IEC 60204-1 and IEC 61496-1. |
| Power Consumption | < 500 mA max. (unloaded) |
| IR Transmitter | Infrared LED (wave length 950 nm) |
| Aperture Angle | According to IEC 61496-2 |
| Operating Condition | IR transmitter ON |
| Functions | Guard Only: On/Off operation with clear/obstructed detection area<br>Test Function: Triggering of system test via external switch- |
| Input Transmitter<br>Machine Test Signal | Minimum duration 100 ms<br>Voltage level for Logic 0: 0…5V DC<br>Voltage level for Logic Hi 1: > 16V DC |
| Outputs:<br>Safety Outputs (OSSDs) | 2 solid state outputs, max. switching capacity 300 mA, short circuit protected |
| QD Connectors | 5 pin M12 for transmitter and receiver |
| Cable Length | Maximum 60 m (197 ft) |
| Ambient Temperature | During operation: 0…55°C (32…131°F); For storage: -20°…60°C (-4…140°F) |
| Humidity of the Air | Up to 95% (without condensation) between 20°C and 55°C (68°F and 131°F) |
| Enclosure Rating | IP65 |
| Vibration Resistance | Per IEC 61496-1, IEC 60068-2-6 Frequency 10…55 Hz Amplitude 0.35 mm |
| Shock | Per IEC 61496-1, IEC 60068-2-29 Acceleration 10 g, Duration 16 ms |
| Material | Housing: Aluminum; Cover: PC (Polycarbonate) |
| Dimensions (cross section) | Approx. 30 x 40 mm (1.18 x 1.57 in.) |
| Accessories Included | Test rod, mounting brackets, operating instructions |
| Approvals | TÜV Rheinland, IEC 61496 Parts 1and 2, UL 61496 Parts 1 and 2, UL 1998 |
| Safety Classification | Type 4 per EN/IEC 61496, Category 4 EN/ISO 13849, SIL 3, IEC 61508, SIL CL3, EN 62061, PLe, EN/ISO 13849 |
| PFHd<br>(Probability of dangerous failure per hour according to EN/IEC 62061 and EN/IEC 61508 (Continuous and high demand mode)) | 7.93E-9 (worst case figure; 32 modules x 30 mm, L = 3840 mm) |
| $T_M$ (mission time) | 20 years (EN ISO 13849) |

**Standard GuardShield Safe 4 with Integrated Laser Alignment System, 14 mm Resolution Catalog Numbers**

| Light Curtain Pair | Transmitter | Receiver | Resolution [mm (in.)] | Protective Heights [mm (in.)] | Response Time | Range [m (ft.)] | Weight per pair (kg) |
|---|---|---|---|---|---|---|---|
| 445L-P4L0120YD | 445L-T4L0120YD | 445L-R4L0120YD | 14 (0.55) | 120 (4.7) | 10.5 ms | 0 . . . 9 (29.5) | 1.9 |
| 445L-P4L0240YD | 445L-T4L0240YD | 445L-R4L0240YD | 14 (0.55) | 240 (9.5) | 15.8 ms | 9 (29.5) | 2.2 |
| 445L-P4L0360YD | 445L-T4L0360YD | 445L-R4L0360YD | 14 (0.55) | 360 (14.2) | 21.2 ms | 9 (29.5) | 2.6 |
| 445L-P4L0480YD | 445L-T4L0480YD | 445L-R4L0480YD | 14 (0.55) | 480 (18.9) | 26.3 ms | 9 (29.5) | 3.0 |
| 445L-P4L0600YD | 445L-T4L0600YD | 445L-R4L0600YD | 14 (0.55) | 600 (23.6) | 34.6 ms | 9 (29.5) | 3.4 |
| 445L-P4L0720YD | 445L-T4L0720YD | 445L-R4L0720YD | 14 (0.55) | 720 (28.4) | 36.8 ms | 9 (29.5) | 4.0 |
| 445L-P4L0840YD | 445L-T4L0840YD | 445L-R4L0840YD | 14 (0.55) | 840 (33.1) | 42.2 ms | 9 (29.5) | 4.4 |
| 445L-P4L0960YD | 445L-T4L0960YD | 445L-R4L0960YD | 14 (0.55) | 960 (37.8) | 47.5 ms | 9 (29.5) | 4.8 |
| 445L-P4L1080YD | 445L-T4L1080YD | 445L-R4L1080YD | 14 (0.55) | 1080 (42.5) | 52.8 ms | 9 (29.5) | 5.1 |
| 445L-P4L1200YD | 445L-T4L1200YD | 445L-R4L1200YD | 14 (0.55) | 1200 (47.2) | 58.1 ms | 9 (29.5) | 5.9 |
| 445L-P4L1320YD | 445L-T4L1320YD | 445L-R4L1320YD | 14 (0.55) | 1320 (52) | 63.4 ms | 9 (29.5) | 6.3 |
| 445L-P4L1440YD | 445L-T4L1440YD | 445L-R4L1440YD | 14 (0.55) | 1440 (56.7) | 68.7 ms | 9 (29.5) | 6.7 |
| 445L-P4L1560YD | 445L-T4L1560YD | 445L-R4L1560YD | 14 (0.55) | 1560 (61.4) | 74 ms | 9 (29.5) | 7.0 |
| 445L-P4L1680YD | 445L-T4L1680YD | 445L-R4L1680YD | 14 (0.55) | 1680 (66.1) | 79.3 ms | 9 (29.5) | 7.5 |
| 445L-P4L1800YD | 445L-T4L1800YD | 445L-R4L1800YD | 14 (0.55) | 1800 (70.9) | 84.6 ms | 9 (29.5) | 7.8 |
| 445L-P4L1920YD | 445L-T4L1920YD | 445L-R4L1920YD | 14 (0.55) | 1920 (75.6) | 85.5 ms | 9 (29.5) | 8.6 |

**Standard GuardShield Safe 4 with Integrated Laser Alignment System, 30 mm Resolution, 0…18 m (0…59 ft) Range of Operation**

| Light Curtain Pair | Transmitter | Receiver | Resolution [mm (in.)] | Protective Heights [mm (in.)] | Response Time | Range [m (ft.)] | Weight per pair (kg) |
|---|---|---|---|---|---|---|---|
| 445L-P4S0120YD | 445L-T4S0120YD | 445L-R4S0120YD | 30 (1.18) | 120 (4.7) | 7.9 ms | 0 . . . 18 (59) | 1.9 |
| 445L-P4S0240YD | 445L-T4S0240YD | 445L-R4S0240YD | 30 (1.18) | 240 (9.5) | 10.5 ms | 18 (59) | 2.2 |
| 445L-P4S0360YD | 445L-T4S0360YD | 445L-R4S0360YD | 30 (1.18) | 360 (14.2) | 13.2 ms | 18 (59) | 2.6 |
| 445L-P4S0480YD | 445L-T4S0480YD | 445L-R4S0480YD | 30 (1.18) | 480 (18.9) | 15.8 ms | 18 (59) | 3.0 |
| 445L-P4S0600YD | 445L-T4S0600YD | 445L-R4S0600YD | 30 (1.18) | 600 (23.6) | 18.5 ms | 18 (59) | 3.4 |
| 445L-P4S0720YD | 445L-T4S0720YD | 445L-R4S0720YD | 30 (1.18) | 720 (28.4) | 21.1 ms | 18 (59) | 4.0 |
| 445L-P4S0840YD | 445L-T4S0840YD | 445L-R4S0840YD | 30 (1.18) | 840 (33.1) | 23.8 ms | 18 (59) | 4.4 |
| 445L-P4S0960YD | 445L-T4S0960YD | 445L-R4S0960YD | 30 (1.18) | 960 (37.8) | 26.3 ms | 18 (59) | 4.8 |
| 445L-P4S1080YD | 445L-T4S1080YD | 445L-R4S1080YD | 30 (1.18) | 1080 (42.5) | 29.1 ms | 18 (59) | 5.4 |
| 445L-P4S1200YD | 445L-T4S1200YD | 445L-R4S1200YD | 30 (1.18) | 1200 (47.2) | 31.6 ms | 18 (59) | 5.7 |
| 445L-P4S1320YD | 445L-T4S1320YD | 445L-R4S1320YD | 30 (1.18) | 1320 (52) | 34.3 ms | 18 (59) | 6.1 |
| 445L-P4S1440YD | 445L-T4S1440YD | 445L-R4S1440YD | 30 (1.18) | 1440 (56.7) | 37 ms | 18 (59) | 6.5 |
| 445L-P4S1560YD | 445L-T4S1560YD | 445L-R4S1560YD | 30 (1.18) | 1560 (61.4) | 39.6 ms | 18 (59) | 6.9 |
| 445L-P4S1680YD | 445L-T4S1680YD | 445L-R4S1680YD | 30 (1.18) | 1680 (66.1) | 42.3 ms | 18 (59) | 7.2 |
| 445L-P4S1800YD | 445L-T4S1800YD | 445L-R4S1800YD | 30 (1.18) | 1800 (70.9) | 44.9 ms | 18 (59) | 7.5 |
| 445L-P4S1920YD | 445L-T4S1920YD | 445L-R4S1920YD | 30 (1.18) | 1920 (75.6) | 47.6 ms | 18 (59) | 8.3 |

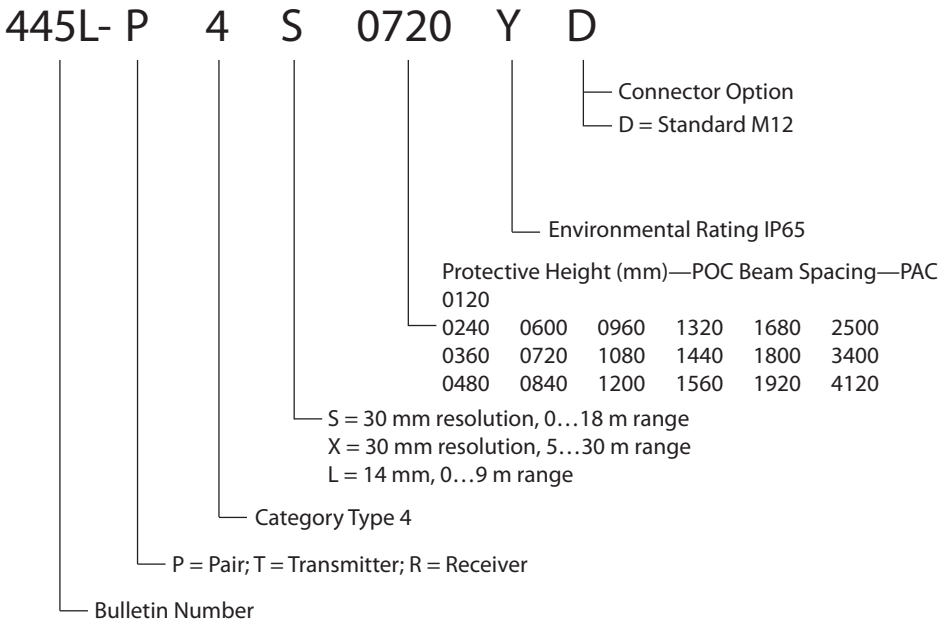
**Standard GuardShield Safe4 with Integrated Laser Alignment System, 30 mm Resolution, 5…30 m (16.4…98.4 ft) Range of Operation Catalog Numbers**

| Light Curtain Pair | Transmitter | Receiver | Resolution [mm (in.)] | Protective Heights [mm (in.)] | Response Time | Range [m (ft.)] | Weight per pair (kg) |
|---|---|---|---|---|---|---|---|
| 445L-P4X0120YD | 445L-T4X0120YD | 445L-R4X0120YD | 30 (1.18) | 120 (4.7) | 7.9 ms | 5 (16.4)…30 (98.4) | 1.9 |
| 445L-P4X0240YD | 445L-T4X0240YD | 445L-R4X0240YD | 30 (1.18) | 240 (9.5) | 10.5 ms | 5 (16.4)…30 (98.4) | 2.2 |
| 445L-P4X0480YD | 445L-T4X0480YD | 445L-R4X0480YD | 30 (1.18) | 480 (18.9) | 15.8 ms | 5 (16.4)…30 (98.4) | 3.0 |
| 445L-P4X0600YD | 445L-T4X0600YD | 445L-R4X0600YD | 30 (1.18) | 600 (23.6) | 18.5 ms | 5 (16.4)…30 (98.4) | 3.4 |
| 445L-P4X0720YD | 445L-T4X0720YD | 445L-R4X0720YD | 30 (1.18) | 720 (28.4) | 21.1 ms | 5 (16.4)…30 (98.4) | 4.0 |
| 445L-P4X0840YD | 445L-T4X0840YD | 445L-R4X0840YD | 30 (1.18) | 840 (33.1) | 23.8 ms | 5 (16.4)…30 (98.4) | 4.4 |
| 445L-P4X1200YD | 445L-T4X1200YD | 445L-R4X1200YD | 30 (1.18) | 1200 (47.2) | 31.6 ms | 5 (16.4)…30 (98.4) | 5.9 |
| 445L-P4X1440YD | 445L-T4X1440YD | 445L-R4X1440YD | 30 (1.18) | 1440 (56.7) | 37 ms | 5 (16.4)…30 (98.4) | 6.7 |

**GuardShield Safe 4 PAC (Perimeter)**

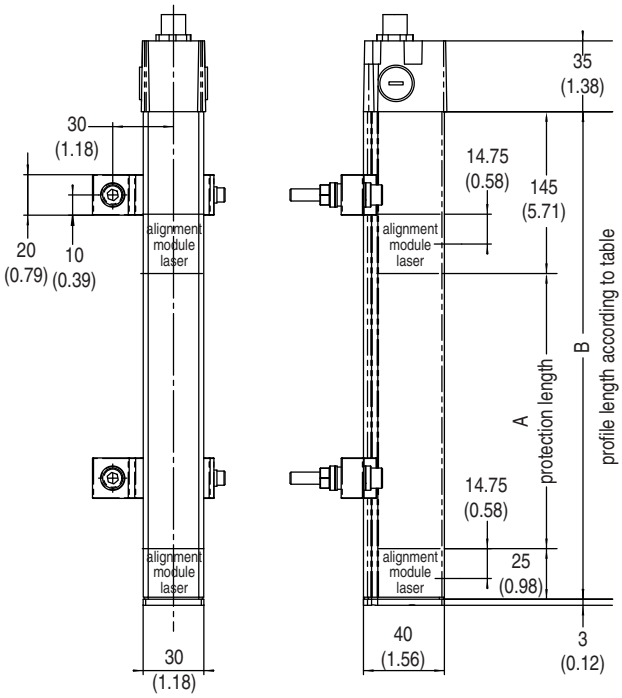
| Catalog No. | Transmitter | Receiver | Number of Beams | Protective Heights [mm (in.)] | Response Time | Range [m (ft.)] | Weight per pair (kg) |
|---|---|---|---|---|---|---|---|
| 445L-P4S2500YD | 445L-T4S2500YD | 445L-R4S2500YD | 2 | 600 (23.6) | 10.5 ms | 5 (16.4)…30 (98.4) | 3.0 |
| 445L-P4S3400YD | 445L-T4S3400YD | 445L-R4S2500YD | 3 | 840 (33.0) | 13.2 ms | 5 (16.4)…30 (98.4) | 3.9 |
| 445L-P4S4120YD | 445L-T4S4120YD | 445L-R4S4120YD | 4 | 960 (37.8) | 15.8 ms | 5 (16.4)…30 (98.4) | 4.2 |
| 445L-103002-0048 | 445L-111464 | 445L-111463 | 2 | 600 (23.6) | 10.5 ms | 0 (0)…18 (59.0) | 3.0 |
| 445L-103002-0003 | 445L-111460 | 445L-111459 | 3 | 840 (33.0) | 13.2 ms | 0 (0)…18 (59.0) | 3.9 |
| 445L-103002-0007 | 445L-111452 | 445L-111451 | 4 | 960 (37.8) | 15.8 ms | 0 (0)…18 (59.0) | 4.2 |

## Catalog Number Configurator


445L- P 4 S 0720 Y D
Connector Option
D = Standard M12
Environmental Rating IP65
Protective Height (mm)—POC Beam Spacing—PAC
0120
0240 0600 0960 1320 1680 2500
0360 0720 1080 1440 1800 3400
0480 0840 1200 1560 1920 4120
S = 30 mm resolution, 0…18 m range
X = 30 mm resolution, 5…30 m range
L = 14 mm, 0…9 m range
Category Type 4
P = Pair; T = Transmitter; R = Receiver
Bulletin Number

## Dimensional Drawings [mm (in.)]

### System with integrated controller




| Type | A Protective Height [mm (in.)] | B Profile Length [mm (in.)] |
|---|---|---|
| 445L-P4❶0120YD | 120 (4.7) | 290 (11.4) |
| 445L-P4❶0240YD | 240 (9.4) | 410 (16.1) |
| 445L-P4❶0360YD | 360 (14.2) | 530 (20.9) |
| 445L-P4❶0480YD | 480 (18.9) | 650 (25.6) |
| 445L-P4❶0600YD | 600 (23.6) | 771 (30.4) |
| 445L-P4❶0720YD | 720 (28.3) | 891 (35.1) |
| 445L-P4❶0840YD | 840 (33.1) | 1011 (39.8) |
| 445L-P4❶0960YD | 960 (37.8) | 1131 (44.3) |
| 445L-P4❶1080YD | 1080 (42.5) | 1252 (49.3) |
| 445L-P4❶1200YD | 1200 (47.2) | 1372 (54.0) |
| 445L-P4❶1320YD | 1320 (52) | 1492 ( 58.7) |
| 445L-P4❶1440YD | 1440 (56.7) | 1612 (63.5) |
| 445L-P4❶1560YD | 1560 (61.4) | 1733 (68.2) |
| 445L-P4❶1680YD | 1680 (66.1) | 1853 (72.9) |
| 445L-P4❶1800YD | 1800 (70.9) | 1973 (77.6) |
| 445L-P4❶1920YD | 1920 (75.6) | 2093 (82.3) |

❶ For 14 mm resolution replace with an "L."
For 30 mm resolution replace with an "S." (0…18 m)
For 30 mm resolution replace with an "X." (5…30 m)

*Figure 20: The profile length for systems without ILAS is reduced for 2 x 25 mm*

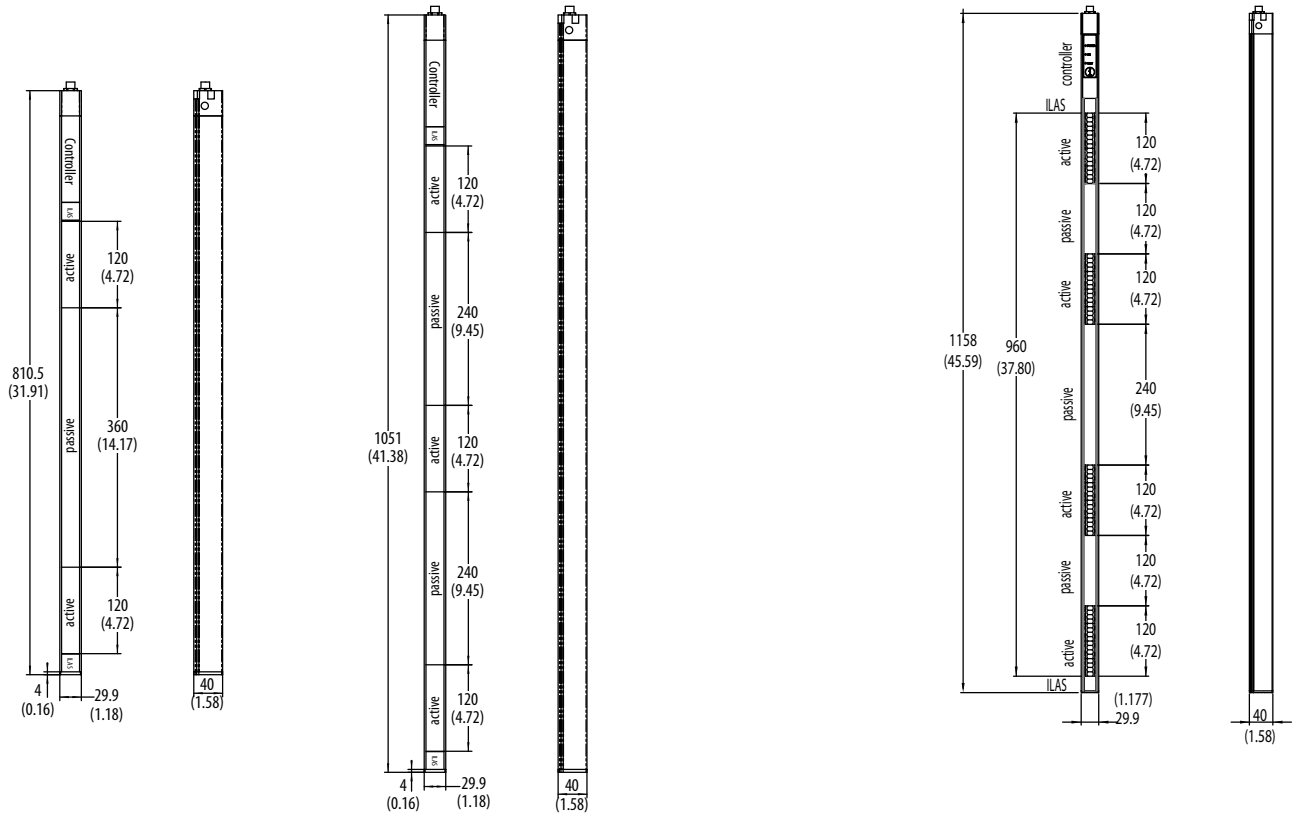



*Figure 21: Safe 4 PAC, two beam, three beam and four beam*

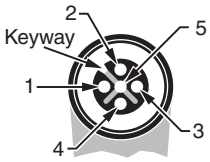
| Female Connector (End) | | Cable | | | |
|---|---|---|---|---|---|
| Face View of Female | Connector Style | Pin / Wire Color | Wire Rating | Length m (ft) | Cat. No. |
|  | Straight Female Nonshielded | 1 Brown<br>2 White<br>3 Blue<br>4 Black<br>5 Grey | 22 AWG<br>250V<br>4 A | 2 (6.56) | 889D-F5AC-2 |
| | | | | 5 (16.4) | 889D-F5AC-5 |
| | | | | 10 (32.8) | 889D-F5AC-10 |
| | | | | 15 (49.2) | 889D-F5AC-15 |
| | | | | 20 (65.6) | 889D-F5AC-20 |
| | | | | 30 (98.4) | 889D-F5AC-30 |
| | Straight Female Shielded | 1 Brown<br>2 White<br>3 Blue<br>4 Black<br>5 Grey | 22 AWG<br>300V<br>4 A | 2 (6.56) | 889D-F5EC-2 |
| | | | | 5 (16.4) | 889D-F5EC-5 |
| | | | | 10 (32.8) | 889D-F5EC-10 |
| | | | | 15 (49.2) | 889D-F5EC-15 |
| | | | | 20 (65.6) | 889D-F5EC-20 |
| | | | | 30 (98.4) | 889D-F5EC-30 |



*Table 3: Cordsets-Transmitter and receivers both use 5-pin M12 cordsets*

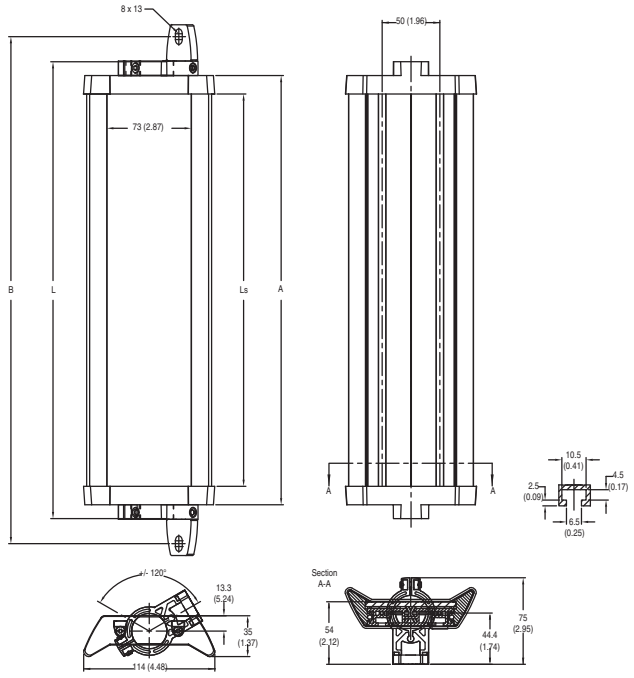
### Required Logic Interfaces

| Description | Safety Outputs | Auxiliary Outputs | Terminals | Reset Type | Power Supply | Cat. No. |
|---|---|---|---|---|---|---|
| **Single-Function Safety Relays for 2 N.C. Contact Switch** | | | | | | |
| MSR127RP | 3 N.O. | 1 N.C. | Removable (Screw) | Monitored Manual | 24V AC/DC | 440R-N23135 |
| MSR127TP | 3 N.O. | 1 N.C. | Removable (Screw) | Auto. / Manual | 24V AC/DC | 440R-N23132 |
| MSR126 | 2 N.O. | None | Fixed | Auto. / Manual | 24V AC/DC | 440R-N23117 |
| **Modular Safety Relays** | | | | | | |
| MSR210P Base 2 N.C. only | 2 N.O. | 1 N.C. and 2 PNP Solid State | Removable | Auto. / Manual or Monitored Manual | 24V DC from the base unit | 440R-H23176 |
| MSR220P Input Module | — | — | Removable | — | 24V DC | 440R-H23178 |
| MSR310P Base | MSR300 Series Output Modules | 3 PNP Solid State | Removable | Auto. / Manual / Monitored Manual | 24V DC | 440R-W23219 |
| MSR320P Input Module | — | 2 PNP Solid State | Removable | — | 24V DC from the base unit | 440R-W23218 |
| **Muting Modules** | | | | | | |
| MSR22LM | 2 N.O. | 1 N.C. | Removable | Auto. / Manual | 24V DC | 440R-P23071 |
| MSR42 (also requires optical Interface 445L-AF6150 for GuardShield Safe 4 configurations) | 2PNP | 2 PNP, configurable | Removable | Auto. / Manual or manual monitored | 24V DC | 440R-P226AGS-NNR |

### Optional accessories:

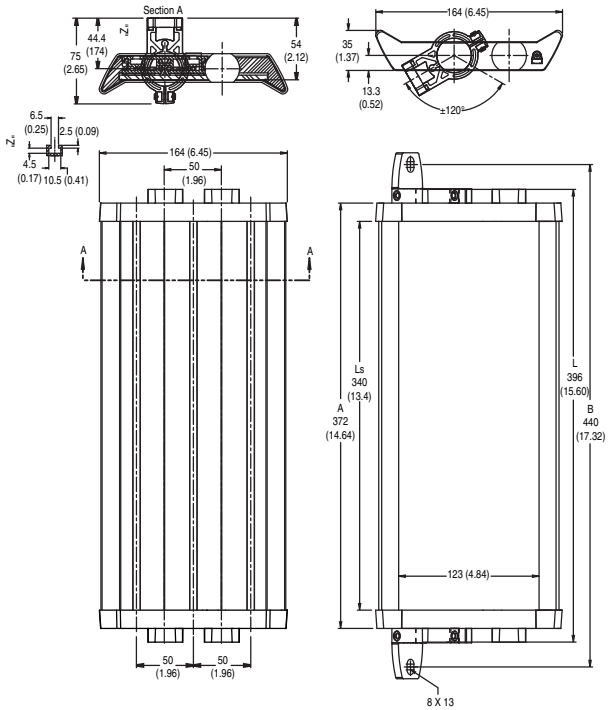
| Description | | Cat. No. |
|---|---|---|
| | Standard kit (4 pieces — supplied with each pair) | 445L-AF6140 |
| | 180° Adjustable kit (two kits required per pair) | 445L-AF6141 |
| | Shock Mount Kit<br>(two kits required per pair of light curtains) | 445L-AF6142 |
| | Vertical mounting kit (two kits required per pair) | 445L-AF6144 |

**Mirror 440L-AM075**




| Model No. | Series | Description | L | $L_S$ | A | B |
|---|---|---|---|---|---|---|
| 440L-AM0750300 | A | Mirror, 300 mm, 4 m | 396 | 340 | 372 | 440 |
| 440L-AM0750450 | A | Mirror, 450 mm, 4 m | 546 | 490 | 522 | 590 |
| 440L-AM0750600 | A | Mirror, 600 mm, 4 m | 696 | 640 | 672 | 740 |
| 440L-AM0750750 | A | Mirror, 750 mm, 4 m | 846 | 790 | 822 | 890 |
| 440L-AM0750900 | A | Mirror, 900 mm, 4 m | 996 | 940 | 972 | 1040 |
| 440L-AM0751050 | A | Mirror, 1050 mm, 4 m | 1146 | 1090 | 1122 | 1190 |
| 440L-AM0751200 | A | Mirror, 1200 mm, 4 m | 1296 | 1240 | 1272 | 1340 |
| 440L-AM0751350 | A | Mirror, 1350 mm, 4 m | 1446 | 1390 | 1422 | 1490 |
| 440L-AM0751500 | A | Mirror, 1500 mm, 4 m | 1596 | 1540 | 1572 | 1640 |
| 440L-AM0751650 | A | Mirror, 1650 mm, 4 m | 1746 | 1690 | 1722 | 1790 |
| 440L-AM0751800 | A | Mirror, 1800 mm, 4 m | 1896 | 1840 | 1872 | 1940 |

**Mirror 440L-AM125**




| Model No. | Series | Description | L | $L_S$ | A | B |
|---|---|---|---|---|---|---|
| 440L-AM1250300 | A | Mirror, 300 mm, 15 m | 396 | 340 | 372 | 440 |
| 440L-AM1250450 | A | Mirror, 450 mm, 15 m | 546 | 490 | 522 | 590 |
| 440L-AM1250600 | A | Mirror, 600 mm, 15 m | 696 | 640 | 672 | 740 |
| 440L-AM1250750 | A | Mirror, 750 mm, 15 m | 846 | 790 | 822 | 890 |
| 440L-AM1250900 | A | Mirror, 900 mm, 15 m | 996 | 940 | 972 | 1040 |
| 440L-AM1251050 | A | Mirror, 1050 mm, 15 m | 1146 | 1090 | 1122 | 1190 |
| 440L-AM1251200 | A | Mirror, 1200 mm, 15 m | 1296 | 1240 | 1272 | 1340 |
| 440L-AM1251350 | A | Mirror, 1350 mm, 15 m | 1446 | 1390 | 1422 | 1490 |
| 440L-AM1251500 | A | Mirror, 1500 mm, 15 m | 1596 | 1540 | 1572 | 1640 |
| 440L-AM1251650 | A | Mirror, 1650 mm, 15 m | 1746 | 1690 | 1722 | 1790 |
| 440L-AM1251800 | A | Mirror, 1800 mm, 15 m | 1896 | 1840 | 1872 | 1940 |

### Corner Mirror for Multi-Sided Guarding

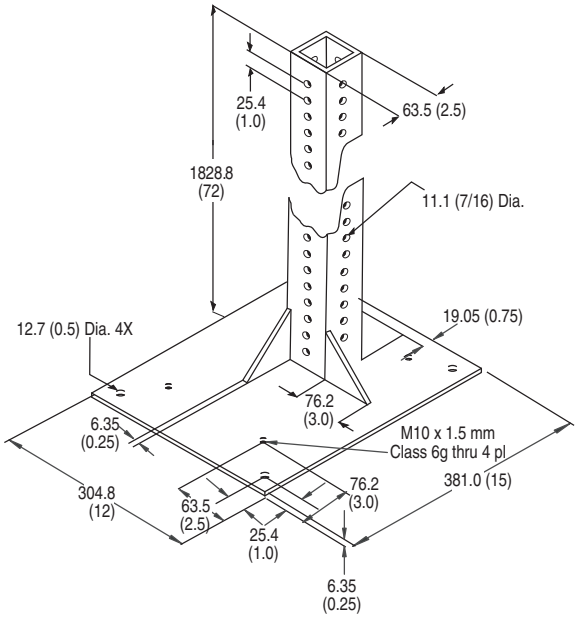
Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

Note: Each mirror reduces maximum scan range by 15% per mirror. Each corner mirror supplied with two end-cap mounting brackets.

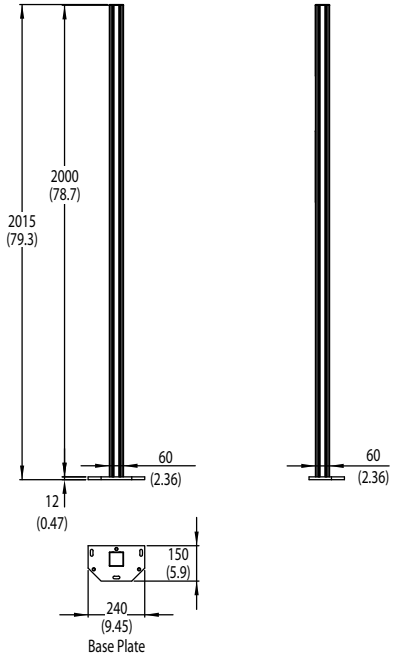
| GuardShield Safe 4 Light Protected Height [mm (in.)] | Narrow Mirror Short-Range 0…4 m | Mirror Height [mm (in.)] | Cat. No. | Wide Mirror Long-Range 4…15 m | Mirror Height [mm (in.)] | Cat. No. |
|---|---|---|---|---|---|---|
| 120/240 (4.7/9.4) | | 300 (11.8) | 440L-AM0750300 | | 300 (11.8) | 440L-AM1250300 |
| 360 (14.2) | | 450 (17.7) | 440L-AM0750450 | | 450 (17.7) | 440L-AM1250450 |
| 480 (19) | | 600 (23.6) | 440L-AM0750600 | | 600 (23.6) | 440L-AM1250600 |
| 600 (24) | | 750 (29.5) | 440L-AM0750750 | | 750 (29.5) | 440L-AM1250750 |
| 720/840 (28/33) | | 900 (35.4) | 440L-AM0750900 | | 900 (35.4) | 440L-AM1250900 |
| 960 (38) | | 1050 (41.3) | 440L-AM0751050 | | 1050 (41.3) | 440L-AM1251050 |
| 1080 (43) | | 1200 (47.2) | 440L-AM0751200 | | 1200 (47.2) | 440L-AM1251200 |
| 1200 (47) | | 1350 (53.1) | 440L-AM0751350 | | 1350 (53.1) | 440L-AM1251350 |
| 1320/1440 (52/57) | | 1500 (59.1) | 440L-AM0751500 | | 1500 (59.1) | 440L-AM1251500 |
| 1560 (61) | | 1650 (65) | 440L-AM0751650 | | 1650 (65) | 440L-AM1251650 |
| 1680 (66) | | 1800 (70.9) | 440L-AM0751800 | | 1800 (70.9) | 440L-AM1251800 |
| 1800/1920 | | None Available | | | None Available | |

### Mounting Stand

**440L-AMSTD**




**445L-AMSTD2M**



# Appendix

## GuardShield Safe4 Specials—for existing customers

### Safety Light Curtain Systems

**Content**

Introduction . . . . . 27
Systems without an Integrated Laser Alignment System (ILAS) 27
Systems with Connector Cap . . . . . 28
Cascaded Systems . . . . . 29
Systems with Separated Controller . . . . . 29
Dimensional Drawings . . . . . 30
Cascaded Systems . . . . . 30
System with Integrated Controller . . . . . 31
Special Systems . . . . . 31
Part List Safe 4 Specials . . . . . 32

## Introduction

In addition to the GuardShield Safe 4 manual this appendix shows some special systems e.g.:

- GuardShield Safe 4 without laser alignment system (ILAS)
- Systems with a hard-wired connection end cap
- Cascaded systems
- Systems with separated controller
- Other special systems

## Systems without an Integrated Laser Alignment System (ILAS)

The systems mentioned in the table below are not equipped with an integrated laser alignment (ILAS) system. So the profile length is reduced by 25 mm on each side of the protective field (see Figure 22).

**GuardShield Safe 4 Systems without Laser Alignment**

| Sensor Pair | Resolution [mm (in.)] | Protective Heights [mm (in.)] | Range [m (ft.)] |
|---|---|---|---|
| 445L-103000-0189 | 14 (0.55) | 120 (4.7) | 9 (29.5) |
| 445L-103000-0044 | 14 (0.55) | 240 (9.5) | 9 (29.5) |
| 445L-103000-0076 | 14 (0.55) | 360 (14.2) | 9 (29.5) |
| 445L-103000-0130 | 14 (0.55) | 480 (18.9) | 9 (29.5) |
| 445L-103000-0036 | 14 (0.55) | 600 (23.6) | 9 (29.5) |
| 445L-103000-0157 | 14 (0.55) | 720 (28.4) | 9 (29.5) |
| 445L-103000-0153 | 14 (0.55) | 840 (33.1) | 9 (29.5) |
| 445L-103000-0140 | 14 (0.55) | 960 (37.8) | 9 (29.5) |
| 445L-103000-0136 | 14 (0.55) | 1080 (42.5) | 9 (29.5) |
| 445L-103000-0195 | 14 (0.55) | 1200 (47.2) | 9 (29.5) |
| 445L-103000-0196 | 14 (0.55) | 1440 (56.7) | 9 (29.5) |
| 445L-103000-0164 | 14 (0.55) | 1560 (61.4) | 9 (29.5) |
| 445L-103000-0034 | 30 (1.18) | 360 (14.2) | 18 (59) |
| 445L-103000-0139 | 30 (1.18) | 480 (18.9) | 18 (59) |
| 445L-103000-0193 | 30 (1.18) | 840 (33.1) | 18 (59) |

**Cascaded GuardShield Safe 4 Systems**

| | | |
|---|---|---|
| 445L-103001-0199 | 30 (1.18) | 1560 / 1320 (61.4 / 52) |
| 445L-103001-0057 | 14 (0.55) | 840 / 240 (33.1 / 9.5) |
| 445L-103001-0121 | 14 (0.55) | 600 / 120 (23.6 / 4.7) |
| 445L-103001-0163 | 14 (0.55) | 120 [120 + 240] (4.7 [4.7 + 9.5]) |

### Systems with Connector Cap for Hard-wired Connection

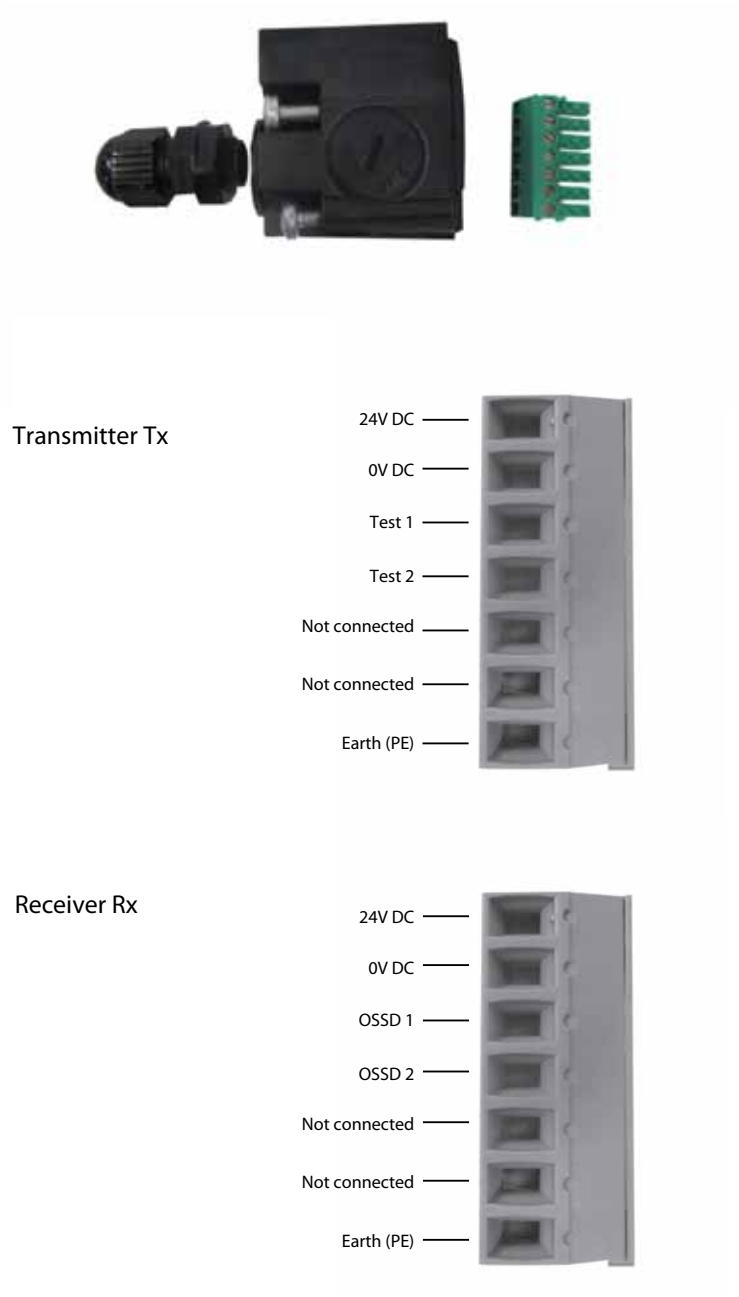



*Figure 22: Pin-out of connector for Safe 4 systems with connector cap*

## Cascaded Systems

### Cascading

The GuardShield Safe 4, Type 4 POC is also available in a limited offering of cascading segments which allow GuardShield Safe 4 transmitters and receivers to be interconnected. This product configurability allows the GuardShield Safe 4 to protect multiple sides of a machine or simply adds flexibility when positioning the GuardShield Safe 4 in various applications.

A maximum of three GuardShield Safe 4 light curtain pairs can be interconnected with a common pair of OSSDs (not to exceed 255 beams).

### Two Segment Cascading GuardShield Safe 4 Systems

#### Typical configuration of a cascaded GuardShield Safe 4

*Figure 23: Cascaded GuardShield Safe 4*

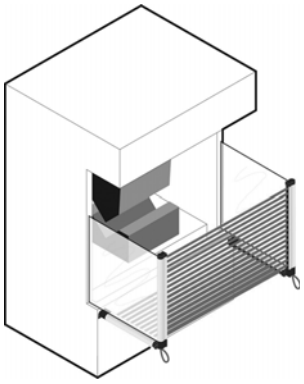


*Figure 24: "L-shaped" two segment GuardShield Safe 4 cascading systems offer protection when it is possible to stand between the vertical light curtain and the machine hazard*

#### Three Segment GuardShield Safe 4 Cascading Systems

When the use of corner mirrors is not practical or possible, three-sided guarding of a machine hazard is possible using cascading GuardShield Safe 4 light curtains.

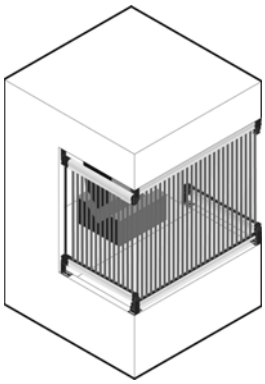
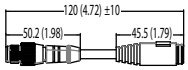
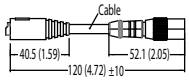


*Figure 25: Top and bottom mounting of 3 GuardShield Safe 4 segments is possible, which will provide three-sided machine guarding without the use of corner mirrors*

Following limitations shall be taken into consideration:

- The protective zone is made of units with 120 mm length
- Ten meter maximum total length for light curtains, extension modules and connection cables combined
- Maximum of three ILAS may be operated simultaneously
- Only the following extension cable may be used between the light curtains

It is possible to extend the length of the cable between cascaded segment pairs, however, it is necessary to use three patchcords to do this. The standard connection between these special Safe 4 light curtains is a DIN 9 connector. To increase the cable length between cascaded segment pairs, a DIN 9 to M12 patchcord is required to connect to the Safe 4 pigtail then an M12 to M12 patchcord connects to the first patchcord. Finally a second M12 to DIN 9 patchcord is required to make the final connection.

| | | |
|---|---|---|
| | 445L-AC8CPx | Patchcord, 8 Pin, 1 Meter, M12 to M12 (x = 1, 3 or 5 meter) |
|  | 445L-ACDN9M12 | Patchcord, 8 Pin, Din9/female to M12/ male |
|  | 445L-109296 | Patchcord, 8 Pin, Din9/male to M12/ female |

## Systems with Separated Controller

Systems with separated controllers are cascaded systems in which one cascade is without any optical modules. The dead zone of the protective cascade is minimized this way. The profile length of light curtains without laser alignment system is 2 x 25 mm shorter.

*Figure 26: GuardShield Safe 4 with separated Controller*

**Cascaded Systems**

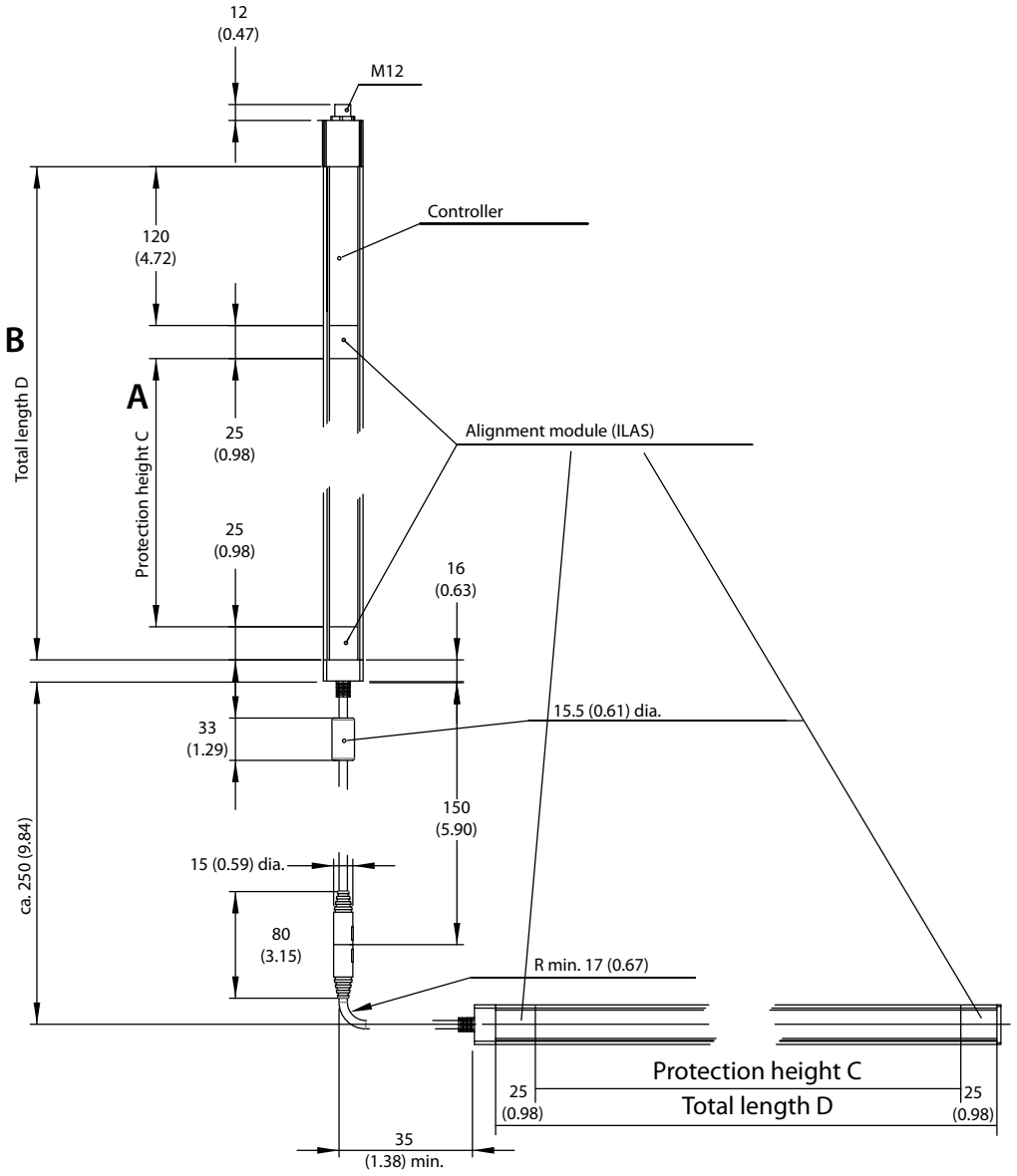



*Figure 27: Cascaded Safe 4 system (not to scale). For lengths A, B, C and D, see table on pages 32 and 33.*

## Special Systems

2 Examples: Part 445L-103005-1002 has six active fields with resolution 30 mm, separated with passive zones. This light curtain is designed for a customer specific machine application.

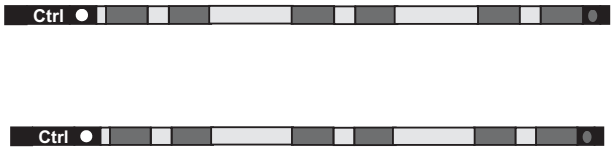



*Figure 28: GuardShield Safe 4 with passive zones (445L-103005-0036)*

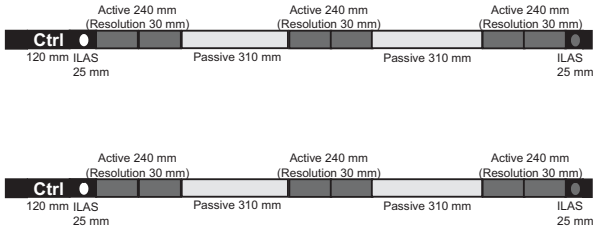



*Figure 29: GuardShield Safe 4 with passive zones (445L-103005-1002)*

Technical data are listed in table on pages 32 and 33.

## Safe 4 Specials Catalog Numbers

| Catalog Number | Protective Height A (mm)* | Total Length B (mm)* | Protective Height C (mm)* | Total Length D (mm)* | Response Time $t_R$ (ms) | Max Range (m) | Resolution (mm) | Weight per Pair (kg) | ILAS | Cascaded (Separate Controller) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Safe 4 without ILAS 14mm - 9m pair** | | | | | | | | | | | |
| 445L-103000-0189 | 120 | 240 | — | — | 10.5 | 9 | 14 | 2.0 | without | No | |
| 445L-103000-0044 | 240 | 360 | — | — | 15.8 | 9 | 14 | 2.2 | without | No | |
| 445L-103000-0076 | 360 | 480 | — | — | 21.1 | 9 | 14 | 2.6 | without | No | |
| 445L-103000-0130 | 480 | 600 | — | — | 26.3 | 9 | 14 | 2.9 | without | No | |
| 445L-103000-0036 | 600 | 720 | — | — | 31.6 | 9 | 14 | 3.4 | without | No | |
| 445L-103000-0157 | 720 | 840 | — | — | 36.9 | 9 | 14 | 3.9 | without | No | |
| 445L-103000-0153 | 840 | 960 | — | — | 42.2 | 9 | 14 | 4.5 | without | No | |
| 445L-103000-0140 | 960 | 1080 | — | — | 47.5 | 9 | 14 | 4.9 | without | No | |
| 445L-103000-0136 | 1080 | 1200 | — | — | 52.8 | 9 | 14 | 5.3 | without | No | |
| 445L-103000-0195 | 1200 | 1320 | — | — | 58.1 | 9 | 14 | 5.6 | without | No | |
| 445L-103000-0099 | 1320 | 1440 | — | — | 63.4 | 9 | 14 | 5.9 | without | No | |
| 445L-103000-0196 | 1440 | 1560 | — | — | 68.7 | 9 | 14 | 6.3 | without | No | |
| 445L-103000-0164 | 1560 | 1680 | — | — | 74.0 | 9 | 14 | 7.0 | without | No | |
| **Safe 4 without ILA 30mm - 18m pair** | | | | | | | | | | | |
| 445L-103000-0034 | 360 | 480 | — | — | 13.1 | 18 | 30 | 2.6 | without | No | |
| 445L-103000-0139 | 480 | 600 | — | — | 15.8 | 18 | 30 | 3.0 | without | No | |
| 445L-103000-0193 | 840 | 960 | — | — | 23.7 | 18 | 30 | 4.4 | without | No | |
| 445L-103000-0118 | 1800 | 1920 | — | — | 44.9 | 18 | 30 | 7.3 | without | No | |
| **Safe 4 with separate controller (Not for new application)** | | | | | | | | | | | |
| 445L-103001-1024 | 0 | 120 | 120 | 170 | 10.5 ms | 9 m | 14 mm | 2.8 kg | with | Sep. ctrl. | |
| 445L-103001-0038 | 0 | 120 | 240 | 290 | 15.8 ms | 9 m | 14 mm | 3.3 kg | with | Sep. ctrl. | |
| 445L-103001-0033 | 0 | 120 | 360 | 410 | 21.1 ms | 9 m | 14 mm | 3.1 kg | with | Sep. ctrl. | |
| 445L-103001-0009 | 0 | 120 | 480 | 530 | 26.3 ms | 9 m | 14 mm | 3.6 kg | with | Sep. ctrl. | |
| 445L-103001-0002 | 0 | 120 | 840 | 890 | 42.2 ms | 9 m | 14 mm | 5.4 kg | with | Sep. ctrl. | |
| 445L-103001-0012 | 0 | 120 | 1080 | 1130 | 52.8 ms | 9 m | 14 mm | 6.2 kg | with | Sep. ctrl. | |
| 445L-103001-0228 | 0 | 120 | 1680 | 1730 | 79.3 ms | 9 m | 14 mm | 7.1 kg | with | Sep. ctrl. | |
| 445L-103001-0229 | 0 | 120 | 1920 | 1970 | 89.9 ms | 9 m | 14 mm | 8.1 kg | with | Sep. ctrl. | |
| 445L-103001-0118 | 0 | 120 | 120 | 120 | 10.5 ms | 9 m | 14 mm | 2.7 kg | without | Sep. ctrl. | |
| 445L-103001-0105 | 0 | 120 | 240 | 240 | 15.8 ms | 9 m | 14 mm | 3.2 kg | without | Sep. ctrl. | |
| 445L-103001-0122 | 0 | 120 | 360 | 360 | 21.1 ms | 9 m | 14 mm | 3.6 kg | without | Sep. ctrl. | |
| 445L-103001-0117 | 0 | 120 | 480 | 480 | 26.3 ms | 9 m | 14 mm | 4.0 kg | without | Sep. ctrl. | |
| 445L-103001-0014 | 0 | 120 | 600 | 600 | 31.6 ms | 9 m | 14 mm | 4.4 kg | without | Sep. ctrl. | |
| 445L-103001-0035 | 0 | 120 | 720 | 720 | 36.9 ms | 9 m | 14 mm | 4.8 kg | without | Sep. ctrl. | |
| 445L-103001-1020 | 0 | 120 | 840 | 840 | 42.2 ms | 9 m | 14 mm | 5.3 kg | without | Sep. ctrl. | |
| 445L-103001-0112 | 0 | 120 | 960 | 960 | 47.5 ms | 9 m | 14 mm | 5.7 kg | without | Sep. ctrl. | |
| 445L-103001-1021 | 0 | 120 | 1440 | 1440 | 68.7 ms | 9 m | 14 mm | 7.3 kg | without | Sep. ctrl. | |
| 445L-103001-1023 | 0 | 120 | 120 | 120 | 10.5 ms | 9 m | 14 mm | 3.0 kg | without | Sep. ctrl. | |
| 445L-103001-1025 | 0 | 120 | 240 | 290 | 10.5 ms | 18 m | 30 mm | 3.1 kg | with | Sep. ctrl. | |
| 445L-103001-1026 | 0 | 120 | 480 | 530 | 15.8 ms | 18 m | 30 mm | 4.1 kg | with | Sep. ctrl. | |
| 445L-103001-0017 | 0 | 120 | 1080 | 1130 | 29.1 ms | 18 m | 30 mm | 6.5 kg | with | Sep. ctrl. | |
| 445L-103001-0094 | 0 | 120 | 1440 | 1490 | 36.9 ms | 18 m | 30 mm | 7.9 kg | with | Sep. ctrl. | |
| 445L-103001-1022 | 0 | 120 | 120 | 120 | 7.8 ms | 18 m | 30 mm | 2.7 kg | without | Sep, ctrl. | |

| **Safe 4 Special Pair** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 445L-103001-0199 | 1560 | 1730 | 1320 | 1370 | 68.7 ms | 18 m | 30 mm | 12.7 kg | with | No | |
| 445L-103001-0023 | 720 | 890 | 240 | 290 | 47.6 ms | 6 m | 14 mm | 5.4 kg | with | No | 90° fixed angle |
| 445L-103005-1002 | 1340 | 1510 | — | — | 21.1 ms | 18 m | 340 mm | 5.6 kg | with | No | |
| 445L-103001-0046 | 240 | 290 | 720 | 770 | 47.6 ms | 6m | 14 mm | 5.4 kg | with | Sep. Ctrl. | 90° fixed angle |
| 445L-103001-0057 | 840 | 1010 | 240 | 290 | 52.9 ms | 6 m | 14 mm | 5.8 kg | with | No | 90° fixed angle |
| 445L-103002-0013 | 840 | 1010 | — | — | 13.2 ms | 18 m | 300 mm | 8.5 kg | with | No | coated window |
| 445L-103000-0068 | 1560 | 1730 | — | — | 74.0 ms | 9 m | 14 mm | 9.1 kg | with | No | coated window |
| 445L-103002-0025 | 1680 | 1800 | — | — | 29.1 ms | 18 m | 180 mm | 2.4 kg | without | No | |
| 445L-103001-0121 | 600 | 600 | 120 | 120 | 37 ms | 6 m | 14 mm | 6.2 kg | without | Sep. Ctrl. | 90° fixed angle |
| 445L-103000-0144 | 960 | 1130 | — | — | 26.3 ms | 30 m | 30 mm | 4.6 kg | with | No | coated window |
| 445L-103005-0036 | 1380 | 1550 | — | — | 21.1 ms | 18 m | 300 mm | 3.3 kg | with | No | |
| 445L-103001-0191 | 720 | 890 | 120 | 170 | 42.3 ms | 6 m | 14 mm | 5.0 kg | with | No | T-connector & 125° fixed angle |
| 445L-103001-0200 | 240 | 360 | 240 | 240 | 26.3 ms | 6 m | 14 mm | 3.5 kg | without | No | 90° fixed angle |
| 445L-103001-0068 | 1200 | 1370 | 960 | 1010 | 79.3 ms | 9 m | 14/30 mm | 9.3 kg | with | No | |
| 445L-103001-0077 | 240 | 240 | 240 | 240 | 26.3 ms | 9 m | 14 mm | 4.1 kg | without | Sep. Ctrl. | |
| 445L-103001-0114 | 840 | 1010 | 240 | 290 | 52.8 ms | 9 m | 14 mm | 5.6 kg | with | No | |
| 445L-103001-0125 | 960 | 1130 | 240 | 290 | 52.9 ms | 9 m | 14/30 mm | 4.7 kg | with | No | |
| 445L-103001-0218 | 720 | 890 | 240 | 290 | 26.3 ms | 18 m | 30 mm | 5.6 kg | with | No | |
| 445L-103001-0219 | 720 | 890 | 360 | 410 | 29.1 ms | 9 m | 30 mm | 6.1 kg | with | No | |
| 445L-103001-0225 | 1080 | 1250 | 120 | 170 | 31.6 ms | 18 m | 30 mm | 6.3 kg | with | No | |
| 445L-103005-0053 | 600 | 770 | — | — | 15.8 ms | 18 m | 150 mm | 4.6 kg | with | No | |
| 445L-103001-0222 | 240 | 410 | 840 | 890 | 291 ms | 30 m | 30 mm | 6.0 kg | with | No | |

# *EC Declaration of Conformity*

| | |
|---|---|
| *The undersigned, representing the manufacturer* | *and the authorised representative established within the Community* |
| ***Rockwell Automation, Inc.*** | ***Rockwell Automation BV*** |
| ***1201 South Second Street*** | ***Rivium 1e Straat, 23*** |
| ***Milwaukee, WI 53204*** | ***2909 LE Capelle aan den IJssel*** |
| ***USA*** | ***Netherlands*** |
| *Herewith declare that the Products:* | ***Safe4 Safety Light Curtains*** |
| *Product identification (brand and catalogue number/part number):* | ***Allen-Bradley / GuardShield 445L Series*** *(reference the attached list of catalogue numbers)* |
| *Product Safety Function* | ***Safe4 safety light curtains are Type 4 active opto-electronic protective devices (AOPD) with resolutions of 14mm and 30mm/PAC. They are cascadeable, and can be used in applications up to Safety Category 4 (EN 954-1)/ SIL3/SIL CL3 (EN 61508 / EN 62061) and PL e (EN ISO 13849-1).*** |

*are in conformity with the essential requirements of the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:*

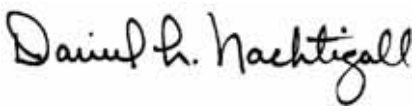
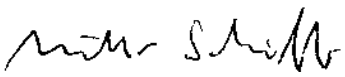
| | |
|---|---|
| *2006/42/EC* | *Machinery Directive* |
| *2004/108/EC* | *EMC Directive* |

*and that the standards and/or technical specifications referenced below have been applied:*

| | |
|---|---|
| *EN 61496-1:2004 + A1:2008* | *Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests* |
| *IEC 61496-2:2006* | *Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPD's)* |
| *EN ISO 13849-1:2008* | *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design* |
| *EN 61508 Parts 1-7:1998-2000* | *Functional safety of electrical/electronic/programmable electronic safety-related systems* |
| *EN 954-1:1997* | *Safety of machinery – Safety related parts of control systems – Part 1: General principles for design* |
| *EN 50178:1997* | *Electronic equipment for use in power installations* |
| *EN 62061:2005* | *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems* |
| *EN 60204-1:2006* | *Safety of machinery – Electrical equipment of machines – General requirements* |
| *EN 61000-6-4:2007* | *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments (Class A)* |
| *EN 61000-6-2:2005* | *Electromagnetic Compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments* |

*Conformance of a type sample belonging to the above mentioned product family with the regulations from the EC Machinery Directive has been certified by:*

| | |
|---|---|
| *TÜV Rheinland Industrie Service GmbH* | *EC Type Examination* |
| *Alboinstrasse 56* | *Registration No: 01/205/0551/09* |
| *12103 Berlin, Germany* | *Report No: 968/M203.02/09* |

| *Manufacturer:* | *Authorised Representative in the Community:* |
|---|---|
|  |  |
| ***Signature*** | ***Signature*** |
| *Name:* *Daniel L. Nachtigall* | *Name:* *Viktor Schiffer* |
| *Position:* *Supv – Product Certification Engineering* | *Position:* *Engineering Manager* |
| *Date:* *25-Mar-2011* | *Date:* *28-Mar-2011* |

*Document Control Number: SEN-0392-C-EN* *1 / 3*

| Catalogue number | Series [1] | Description |
|---|---|---|
| 445L-x4xxYD | | GuardShield Safe4 safety light curtain per Nomenclature |
| 445L-1xxxxxx-xxxx | | GuardShield Safe4 safety light curtain per Nomenclature |
| 445L-1xxxxxx | | GuardShield Safe4 safety light curtain per Nomenclature |
| 445L-R4S2500YD | | GuardShield Safe4, PAC receiver, 30 mm resolution, 2 beam, 500 mm spacing |
| 445L-T4S2500YD | | GuardShield Safe4, PAC transmitter, 30 mm resolution, 2 beam, 500 mm spacing |
| 445L-P4S2500YD | | GuardShield Safe4, PAC receiver/transmitter pair, 30 mm resolution, 2 beam, 500 mm spacing |
| 445L-R4S3400YD | | GuardShield Safe4, PAC receiver, 30 mm resolution, 3 beam, 400 mm spacing |
| 445L-T4S3400YD | | GuardShield Safe4, PAC transmitter, 30 mm resolution, 3 beam, 400 mm spacing |
| 445L-P4S3400YD | | GuardShield Safe4, PAC receiver/transmitter pair, 30 mm resolution, 3 beam, 400 mm spacing |
| 445L-R4S4120YD | | GuardShield Safe4, PAC receiver, 30 mm resolution, 4 beam, 300 mm spacing |
| 445L-T4S4120YD | | GuardShield Safe4, PAC transmitter, 30 mm resolution, 4 beam, 300 mm spacing |
| 445L-P4S4120YD | | GuardShield Safe4, PAC receiver/transmitter pair, 30 mm resolution, 4 beam, 300 mm spacing |

*1) If no series number is given, then all series are covered*

*NOMENCLATURE:*

*Standard 445L Series Nomenclature:*

| 445L | - | P | 4 | S | 0960 | Y | D |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | 3 | 4 | 5 | 6 | 7 |

| | | | |
|---|---|---|---|
| 1. | Designates Product Line<br>445L – GuardShield safety light curtain | | |
| 2. | Designates Optic Head Designation<br>P – Transmitter and receiver pair<br>R – Receiver<br>T – Transmitter | | |
| 3. | Designates AOPD Safety Type<br>4 – Type 4 | | |
| 4. | Designates Photoelectric Safety Device and Sensing Resolution<br>L – Safe4, 14 mm sensing / operating range 0…9 m<br>S – Safe4, 30 mm sensing / operating range 0…18 m<br>X – Safe4, 30 mm sensing / operating range 5…30 m | | |
| 5. | Designates Protective Height<br>0120 – 120 mm<br>0240 – 240 mm<br>0360 – 360 mm<br>0480 – 480 mm<br>0600 – 600 mm<br>0720 – 720 mm | 0840 – 840 mm<br>0960 – 960 mm<br>1080 – 1080 mm<br>1200 – 1200 mm<br>1320 – 1320 mm<br>1440 – 1440 mm | 1560 – 1560 mm<br>1680 – 1680 mm<br>1800 – 1800 mm<br>1920 – 1920 mm<br>2040 – 2040 mm<br>2160 – 2160 mm |
| 6. | Designates Environmental Rating<br>Y – IP65 | | |
| 7 | Designates Connection Type<br>D – Micro-style quick disconnect, M12 | | |

*NOMENCLATURE (Cont):*

*Custom 445L Series Nomenclature (1):*

| *445L* | - | *103000-0000* |
|---|---|---|
| *1* | | *2* |

| | |
|---|---|
| *1.* | *Designates Product Line*<br>*445L – GuardShield safety light curtain* |
| *2.* | *Designates Custom Catalog Designation*<br>*Any number from 100000-0000…199999-9999 can be used to denote custom catalog numbers for the 445L Series light curtains* |

*Custom 445L Series Nomenclature (2):*

| *445L* | - | *105000* |
|---|---|---|
| *1* | | *2* |

| | |
|---|---|
| *1.* | *Designates Product Line*<br>*445L – GuardShield safety light curtain* |
| *2.* | *Designates Custom Catalog Designation*<br>*Any number from 100000…199999 can be used to denote custom catalog numbers for the 445L Series light curtains* |

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